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INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS
ICAE
29th | Milan Italy 2015
UNIVERSITÀ DEGLI STUDI DI MILANO AUGUST 8 - 14
AGRICULTURE IN AN INTERCONNECTED WORLD

AUGMENTING FOOD SECURITY THROUGH AGRICULTURAL INPUT SUBSIDY: Anevaluation of National Agricultural Input Voucher Scheme (NAIVS) with impact onFemale-headed Households in Tanzania

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Agricultural input subsidies have often been promoted as the solution to target food insecurity. This paper aims to investigate the impact of the National Agricultural Input Subsidy (NAIVS) on small-scale farmers in Tanzania particularly, for household food security, while investigating if the programme had any differential impact on female-headed households.

On examining the general impact of the NAIVS on small-scale farmers, it is clear that the programme did affect food-security at the household level. Literacy also had a significant impact on household food-security and in terms of production.

In terms of the specific impact of the programme on female-headed households, beneficiary female-headed households preferred spending more on education, birth control and family planning.They were also more food-secure and consumed more meals on an average, while the non-beneficiary households preferred spending more on food -- suggesting a lack of food self-sufficiency. However this cannot be attributed the input subsidy alone and needs further research.

This paper aims to inform policy-making around agricultural input subsidies and its impacts on female headed households.

IAAE

The Impact Evaluation was funded by the World Bank, 3ie (International Initiative for Impact Evaluation) and the team included researchers from University of California, Berkeley. The data collection was facilitated by REPOA (Policy Research for Development) and Ministry of Agriculture, the United Republic of Tanzania, Africa.

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Acknowledgement

I'd like to thank the Department of Masters in Development Practice - School of Natural Sciences, Trinity College Dublin, and the School of Politics at the University College Dublin. I'd also like to thank Policy Research for Development (REPOA), The World Bank and 3ie (International Initiative for Impact Evaluation).

There are a number of people who've provided help and guidance for this research.

From the MDP department, I'd like to thank my dissertation supervisor Prof. Michael King for his useful insights and motivation; Catriona Logue for her continued support and feedback with statistical analysis. Secondly, I'd like to thank Dr. Susan Murphy for her support with research placement and the feedback on preliminary analysis of the data and Elaine Elderse for administrative support.

From REPOA, I would like to thank Dr.BlandinaKilama for overall feedback on how to conduct a policy analysis, ThadeusMboghoina for readily answering any data related queries, SamwelEbenezeri, and Cornel Jahari for sharing his experiences on what goes on in the field in Tanzania.

From the World Bank, I would like to thank Dr. David Rohrbach, Senior Agricultural Economist, for his feedback on the preliminary research question and Rosalie Ferraro for providing the document support.

I'd also like to thank my colleagues at J-PAL (Poverty Action Lab). Without their motivation, completing a dissertation along with a full-time job might not have been possible. I'd like to particularly thank my co-RA, SaurabhBhajibhakre.

This dissertation is dedicated to my family and anyone else who enjoys reading about the impact of input subsidies with a gendered lens.

Section 1

1.1 Summary

Agricultural input subsidies have often been promoted as the solution to target food insecurity. This paper aims to investigate the impact of the National Agricultural Input Subsidy on small-scale farmers in Tanzania particularly, for household food security, while investigating if the programme had any differential impact on female-headed households.
Data was collected by the REPOA (Policy Research for Development, Tanzania) on behalf of the World Bank and the Tanzanian Ministry of Agriculture. The datasets used for the analyses comprise a pooled household dataset – wherein, beneficiary and non-beneficiary households across eight regions in Tanzania were surveyed on various aspects of outcome of interests and the non-beneficiary households served as the comparison group or the counterfactual for the research. A separate Gender Module Survey was administered by the REPOA with support from 3ie and the University of California, Berkeley; this dataset was used for descriptive analyses to check the impact of input subsidies on female-headed households in terms of food security, entrepreneurship, health services, violence and decision-making.
Food security in particular was measured by a fixed effects multivariate regression analysis controlling for factors that could affect the outcome of interest (i.e. Food security) otherwise, such as, male-headed households, literacy levels, regional variation and the area of total land owned. Descriptive statistics, pre-post methods of analyses and simple regression and t-tests were used to analyse other research questions of interest, such as, maize productivity, heterogeneous impact of the programme and the effects for the female-headed households.
The key findings of the analyses were -- the seemingly positive impact of the Agricultural Input Subsidy on household food security; literacy also had a statistically significant positive relationship with food security. In terms of maize productivity, the pre-post results from the year 2009/10 to 2010/11 seemed to be positive with beneficiary households having a higher level of productivity; however, beneficiaries were wealthier than the non-beneficiaries on an average hence, the higher yield results may not be solely attributed to the programme. A simple regression analysis does suggests some level of elite capture -- the politically connected farmers grabbing the subsidy vouchers issued more to those who had regular social interaction with the Village Hamlet or the Village Executive. Considering the heterogeneous impacts, simple descriptive statistics suggest that male-headed households had a higher maize harvest and higher income as compared to female-headed ones but further analyses is needed to explain the case. One reason could be that there were systematic differences between male-and female-headed households i.e. the former owned more land and higher total cultivable area.
In terms of the specific impact of the programme on female-headed households, I compared the beneficiary female-headed households to the non-beneficiary female-headed households and the analyses showed the former preferred spending more on education, birth control and family planning. They were also more food-secure and consumed more meals on an average, while the non-beneficiary households preferred spending more on food -- suggesting a lack of food self-sufficiency. Since there were no major systematic economic differences (measured by total area of land owned, cultivable land owned and dwelling occupancy status) between the beneficiary and non-beneficiary female-headed households, the effect on household food security could be potentially attributed to the programme.
In terms of access to health services, it was easier for the beneficiary female households to acquire medical treatment/consultation as compared to the non-beneficiary households, with statistically significant differences. The data was insufficient to draw any causal link between decision-making,

intimate relationship-violence and the programme. Perhaps more qualitative focused group discussions would have helped explore these dynamics. Further research is required in this aspect. Given the Tanzanian Government's high investments in agricultural subsidies, this paper aims to inform policy-making around agricultural input subsidies in relation to the effects on household food security and differential effects on female-headed households. Whether these lessons from Tanzania hold true for other countries or not, depends on the context.

1.2 Introduction

This paper examines key indicators identified in the implementation of the NAIVS, i.e., awareness of the programme and the administrative bottlenecks in service delivery; the programme's impact on household food security. The analyses aim at gauging the effects of the subsidy on female-headed households. The paper includes and reflects -- apart from the analyses from baseline data -- upon the following datasets: a) pooled household data from two years (2010/11–2011/12) across eight regions in Tanzania (refer to Methodology section). The total number of households for the purpose of this analyses were 1,863 – 51% beneficiaries and 49% non-beneficiaries b) Listing data (farmers who received vouchers for three consecutive years) c) Gender dataset i.e., data specifically collected from female-headed households.
The major research objective was to assess if the National Agricultural Input Voucher Subsidy scheme in Tanzania impacted household food-security among the small-scale farmers while further assessing the programme's impact, (if any), on female-headed households.
Section I explains the background and context of the research, and points out key aspects from the existing literature on agricultural input subsidies, food security and women and, agriculture.
Section 2 details the research design, and then, the research method for each outcome of interest in the study namely -- food security, maize productivity and the differential impacts on female-headed households.

Section 3 is divided into three parts and describes the results obtained from the analyses and discusses them. This section is divided into two parts -- Part A of Section 3 discusses the general implementation of the programme, such as, the targeting criteria, elite capture and administrative bottlenecks. Part B of this section lists the impact of agricultural input subsidies on household food security by using a multivariate regression model specification and the impact on maize productivity using a pre-post analysis. Part C discusses differential heterogeneous impacts of the programme – if any -- on our population of interest stratified by the gender of the head of the households and further dwells on the programme's impact on female-headed households with regard to household food security, financial spending preferences, access to health services and decision-making.
Section 4 concludes with the overall impact of the programme on small-scale farmers in Tanzania followed by recommendations.

1.3 Background & Literature Review

1.3.1 Agriculture in Tanzania

Agriculture is the main source of livelihood in Tanzania, with nearly two-thirds of the population employed here and almost 50% of Tanzania's GDP dependent on this sector. Agricultural input subsidies were once touted as an antidote to food security for small-scale farmers, however, given the structural adjustments, many subsidies were withdrawn during the 1980s-1990s (Crawford et al,). With focus back on agricultural subsidies as the medium to ensure food security for households

in sub-Saharan Africa (SSA) the aim is to increase production of staple crops -- maize and paddy while ensuring household food-security. The penetration and adoption of agricultural input use – such as improved seeds and inorganic fertilizers is significantly low in sub-Saharan Africa as compared to regions such as South Asia countries and South America (Dittoh, 2012). Thus the objective of these subsidies is to promote technology input adoption among farmers in order to improve production and productivity. While that is one justification often cited by many scholars for input subsidies, there are economists who feel that subsidies are expensive, distort market prices and bare the risk of commercial displacement of these inputs (Baltzer, 2011). To offset these prospective disadvantages, many SSA countries like Malawi, Zambia and Tanzania came up with 'market-smart subsidy' (1) which aim to increase the effects with the minimum costs possible. Market smart subsidies also aim to promote networks of agro-dealers and business development (Morris et al, 2007). This study focuses on the Tanzanian agricultural input voucher subsidy. Given the broad scope of agricultural subsidies, what links these programmes is that all of them have either a combination of improved seeds and fertilizers or at least one of each. Using these inputs is fundamental to the modern agricultural setting (Baltzer, 2011), so while Asia and Latin America witnessed and benefitted from the Green Revolution (2), this wave did not largely affect the countries in Sub-Saharan Africa. The region has the lowest percentage of agricultural input-use. While in South Asia, the farmers used 100kg of fertilizer per ha, and 73 kg per ha was used in Latin America, in SSA, farmers used only 9kg per ha as per 2002-2003 statistics (Crawford et al, 2006). As a result, SSA did not experience increased production as such, and that potentially increased dependence on grain imports (Wiggins and Brooks, 2010; Future Agricultures, 2010).

1. Market Smart Subsidy: Morris et al. (2007) identify aspects of a smart-market subsidy as*:* "*(i) promotes the factor or product as part of a wider strategy that includes complementary inputs and strengthening of markets; (ii) favors market-based solutions that do not undermine incentives for private investment; (iii) promotes competition and cost reductions by reducing barriers to entry; (iv) insists on economic efficiency as the basis for fertilizer promotion efforts; (v) recognizes that effective demand from farmers is critical for long-run sustainability; (vi) devises an exit strategy to limit the time period of public interventions; (vii) emphasizes sustainability as a goal when designing interventions; (viii) promotes pro-poor growth, in recognition of the importance of equity considerations; (ix) empowers"*.

From the 1960s up to the 1980s, many countries in SSA, including Tanzania, pursued the framework of 'Universal' subsidies (Doward, 2009). In case of the Universal Subsidy Framework, much of the inputs and subsidy prices were controlled by the Government and most countries had diverse experiences. However, the drawbacks of these subsidies – such as, high administrative costs, elite capture by better-off or well-connected farmers, were not sustainable in the long run and hence, as structural adjustments commenced, these were phased out. In 2006, however, the New Partnership for African Development laid out the Abuja Declaration that aimed at the African Green Revolution with a target of increasing fertilizer usage by 50kg per ha. This declaration initiated a move towards Market Smart Subsidies (Tiba, 2009). This programme targeted a specific segment of farmers with set criteria aimed at promoting private networks of market development and came equipped with an exit strategy -- which universal subsidy programmes in general, lacked previously. The National Agricultural Input Voucher Scheme (NAIVS) was thus, introduced as a Smart Market Subsidy in Tanzania.
One of the crucial aims and justifications of agricultural input subsidies was that it could help ensure household food-security. The input subsidy was likely to decrease the cost of production of staples like maize and rice (see Theory of Change, Figure 1.1 in Methodology section), however, an input subsidy like NAIVS did not aim at the 'food basket' of households i.e., food security in terms of nutritional value or the dietary diversities since the inputs were targeted towards staple crops only. Evidence from the Malawi Input Subsidy Programme further reiterated that input subsidy was

critical to improving household food-security (Dorward et al, 2009; 2012). Therefore, it is essential to explore the case of Tanzania to examine if the subsidy did at all impact household food-security.

1.3.2 Women and Agriculture

Women are central to the agricultural sector in Tanzania and account for almost half of the labour force here, which is why agriculture matters more to them. Statistics indicate that 80% of the women are engaged in agriculture as compared to 73% of men and the figure is higher for rural areas where 98% of the women earn their living from agriculture (Anderson, 2011). Altogether 55% of women are engaged in agriculture in Tanzania, which is greater than the regional average of SSA.

Given this backdrop, it is surprising that women own much lesser total and cultivable land than men (0.21-0.3 ha for women and 0.61-0.7ha for men) (Anderson, 2011). While both, women and men farm, time studies and census data also show that in terms of labour-time, women are comparatively more active than men; and while men are engaged with cash crops and income-generating activities, it falls on women to ensure food-security and engage with staple food crops (Anderson, 2011). Income control from these activities is also likely to be more for men. This is however, not marked by a complete absence of conflict because spending priorities differ for both genders -- men prefer spending on personal goods whereas, women spend more on food-security (Wandel, 1991). There is little existing literature on the impact of agricultural input subsidies on female-headed households so the paper aims to highlight the key impact of the National Agricultural Input Subsidy Voucher Scheme (NAIVS) on small-scale farmers in Tanzania; while exploring its impact on female-headed households as the population of interest.

1.3.3 The Programme

Tanzania's agriculture sector is fraught with many complexities -- low technology-adoption, low usage of fertilizers and lack of improved seed varieties -- which curb and prove detrimental to economic productivity and food-security with nearly 70% small-scale farmers impacted significantly. Evidence suggests at the direct relationship of the linkages between agricultural production and poverty, mapped with data from farmers who depend fully on the sale of food crops (National Bureau of Statistics, 2002).

The NAIVS, introduced as a Smart Market Subsidy in Tanzania, was launched in response to the high food and fertilizer prices in 2007-08. Small-scale farmers in Tanzania, which comprised 70% of the population, used fertilizers even below the SSA average i.e. 8kg per ha as compared to 9kg per ha (World Bank, 2009). It impacted the productivity of staple crops in Tanzania considerably but indirectly and in turn, impacted household food-security given low agricultural productivity in Tanzania compared to international standards (World Bank, 2009). In the face of spiralling food and fertilizer prices, the Government justified the launch of the programme to promote technology-adoption amongst small-scale farmers and thus, increase productivity.

By providing a 50% subsidy for the purchase of chemical fertilizers and improved seeds to maize and rice farmers in high potential areas of Tanzania, the programme, aimed to reach 2.5 million farmers by 2011. It was developed in response to the food crisis that peaked in the late 2000s since the goal of NAIVS was to improve access and adoption of critical agricultural inputs in order to boost food production and reduce pressure on prices of food staples, thereby, increase incomes and bolster food security (World Bank, 2009). The input package provided by the programme contained vouchers for three inputs: basal phosphate fertilizer, urea top dressing and improved maize (hybrid or OPV) or paddy seeds.

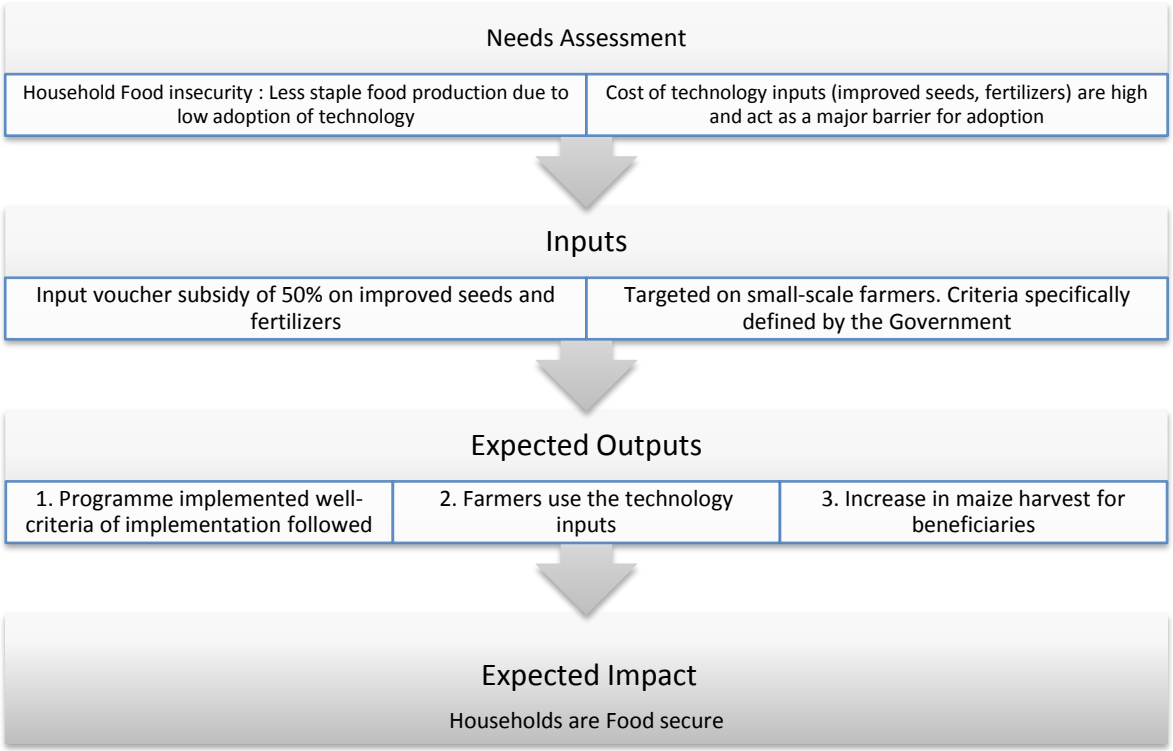
Households were selected to become beneficiaries through a Village Voucher Committee (VVC) using stipulated programme criteria. Each voucher had a face value of approximately half the cost of the input in the given region, as determined by the MAFC before the commencement of the planting season, and could be redeemed with agro-dealers, certified to handle vouchers by the local district government.

However, the criteria included – a) Not owning more than 2.5 acres of cultivable land b) the farmer should be able to co-fund the remaining 50% of the cost c) Should not have used commercial inputs in the last 2 years (in order to avoid commercial displacement) d) Female-headed households were to be given preference (MAFC, 2012). Farmers had to present the voucher along with the additional top-up payment to receive the inputs; agro-dealers then submitted the vouchers to the local National Microfinance Bank (NMB) branch in order to be reimbursed for the face value of the voucher. Since input subsidies had been touted as an antidote to low agricultural production, it was essential to examine its impact and more so, when the structure of the subsidy differed from a universal subsidy. One of the crucial aims and justifications of agricultural input subsidies was that it could help ensure household food-security.

2. Methodology

This section describes the methods used to conduct the research. It details the sampling procedure, followed by the means of data collection and analysis. The Theory of Change is illustrated to explain the logic of the research objective and the parameters to be considered.

Theory of Change (Fig 1.1)



2.1 Research Design

Baseline results provide some guidelines for evaluating the progress of the NAIVS. The follow-up study in 2012, mimicked the timing of the baseline and ensured the comparability of responses related to planting and harvest. Changes to the follow-up survey sample included: (a) capturing a larger sample of programme 'graduates' who had received vouchers for three years to assess the sustainability of the programme's effects, and (b) interviewing households in the newly added NAIVS districts that fell outside the high-potential growing zones in order to estimate average yield gains across agro-ecological zones (REPOA, 2012)

2.2 Study Implementation

The Tanzanian research firm, Policy Research for Development, undertook the survey fieldwork in partnership with researchers from MAFC and the World Bank. The study was designed to focus on the universe of eligible farming households and compare voucher beneficiaries (treatment group) with eligible non-beneficiaries (control group).

2.3 Stratified Sampling

2.3.1. Sampling Regions, Districts, and Villages

Regions

The follow-up study sample revisited the eight regions that were covered in the baseline as well as the two new regions -- Tabora and Dodoma. These new regions were outside the high potential growing zones originally focused on by NAIVS and therefore, served as case studies for the efficacy of expanding the programme across the country. These two particular regions were selected because they were among the driest parts of the country.

Districts

The ten original districts from the baseline were revisited in addition to the two new ones, which were selected from a sample of districts added to the programme during the 2010-11 cycle.

Regions/Districts	
Northern Highlands:	*Southern Highlands:*
Arusha (Meru)	Morogoro (Ulanga)
Kilimanjaro (Same)	Ruvuma (Tunduru)
	Iringa (Kilolo&Njombe DC)
Dry Zones:	Mbeya (Mbeya Rural &Mbozi)
Tabora?	Rukwa (Sumbawanga DC)
Dodoma?	Kigoma (Kasulu)

Villages

The original sample of 80 villages from the Southern regions remained the same for the follow-up study and all households from the listing and households surveys were re-interviewed. In the bi-modal regions, since targeting interventions were conducted as planned only in the Meru district, households in 46 villages of Meru were oversampled while those from Same and Ulanga were cut to compensate. Sixteen villages each, from Same and Ulanga, remained in the survey, bringing the

total number of original villages revisited, to 158 (80 southern + 46 Meru + 32 Same/Ulanga). Within the new districts of X and Y, 10 villages were surveyed per district (REPOA, 2012).
*Note – Many of the villages in the Ulanga sample did not start receiving vouchers until 2010-11, therefore, there were no programme 'graduates'. These villages were dropped by REPOA.

2.4. Survey Instruments

1. *Listing Survey* - collected data on NAIVS eligibility criteria, basic descriptive statistics, and yields data. It would be conducted with households in the newly added districts, as opposed to a household survey. An expanded listing survey would be administered to farmers who received vouchers for the first three years of the programme (also known as programme "graduates").

Note: we do not know which villages in Ruvuma, Mbeya, Kigoma and Rukwa started receiving vouchers in 2008 (and therefore, had programme graduates). Chances were they all did because these regions were widely covered.

2. *Household Survey* – collected data related to programme awareness and satisfaction, household economy and plot-level inputs and outputs. Female-headed households and other women of reproductive age were also administered a series of gender-based modules as part of UC-Berkeley's study.

Research Objectives

3.1 Hypothesis 1: NAIVS impacted household food security positively/NAIVS made households more food-secure.

The assumption made for this hypothesis is that receiving the agricultural input subsidy should ideally result in improved food availability and food-security for beneficiary households. To evaluate this, I used the pooled household data, with specific questions asked of the respondents for food-security. The follow-up household data from year 2012 was utilized here.
I used the question, "How often did you worry that your household would not have enough food in the past 30 days?" for my model specification. I created a dummy variable called Food-secure=1 if the household a) never worried b) rarely worried i.e. once or twice in the past 30 days; and to measure food-security, I ran a fixed effects regression (controlling for the region) on the dependent variable Food-secure on the dummy variable BeneficiaryA1=1, if the household received NAIVS vouchers, and BeneficiaryA2=1, if the household did not receive the NAIVS vouchers. I controlled for variables -- Male household head, literacy and total area of land owned.

$$xi: \gamma = \alpha + b_1X_1 + b_2X_{2...E}$$

(1)Food security = Beneficiary (1) + Male Household Head + Literacy + Primary Education+ Total area of land owned+ i.region

The strength of this model specification lay in its control over total area of land owned -- which was one of the main socio-economic differential baseline characteristics between the beneficiaries and the non-beneficiaries. The equation also controlled for the regional variations by adding region-fixed effects.
Another dummy variable -- Food-insecure was created for the question "How often did you worry that your household would not have enough food in the past 30 days?" If the household answered a) worried sometimes i.e. three to ten times in the past 30 days or b) worried often i.e. more than 10 times in the past 30 days. This dependent variable was then regressed on independent variables -- being a Non-beneficiary, having a Male Household Head, not literate and area of land owned.

(2) Household Food Insecurity = Non-Beneficiary + low Literacy + Male Household Head + total area of land owned + i.region

To analyze the impact of the National Agricultural Input Subsidy on food security, I further examined more variables and a few descriptive statistics. Households were questioned on how

many meals per day they /their household members had consumed on an average in the a) last 30 days and b) in the typical month in the lean period, I ran a t-test to examine the differences between beneficiary and non-beneficiary households.
In order to investigate the impact of usage of urea fertilizer as an agricultural input on food security, I ran another linear regression between food-security as the dependent variable and the quantity of fertilizer (urea) used on land as an independent variable. This gave the impact of a subset of a programme as urea was one of the agricultural inputs for which, subsidy was given to small-scale farmers. The justification for analyzing urea over any other input that NAIVS had was that urea was among the most-used fertilizer among small-scale farmers in Tanzania (reference).

3.2 Hypothesis 2: NAIVS positively impacted maize production and productivity

To investigate the effects of NAIVS on maize production, I used the Listing Data (please refer the Methodology section), the maize yields with and without vouchers and compared them for the years 2009-10 and 2010-11. This was mainly a pre-post evaluation and may not attribute a very strong causal link between the programme and the production. Factors, such as, average rainfall variations across regions could also impact production of maize and this was not accounted for in the analyses. From the Listing Dataset, I divided the variable – acres of land in which maize was cultivated by the produce in that season to get the variable Productivity for that particular season of the year.
Productivity = total acres of land on which maize was cultivated / Maize produced that year (kg)
Further, to investigate the differences in production, the total quantity of maize harvested between the beneficiary and non-beneficiary households were compared using household data. The difference was measured by running a t-test between the total quantities of maize harvested for the beneficiaries and non-beneficiaries. To cross-verify, the production and productivity results are then matched with the perceived outcomes of the programme, wherein, respondents were asked if they felt the programme increased their incomes and yields.

3.3. Hypothesis 3: NAIVS had heterogeneous impacts on male- and female-headed households

The assumption here is that NAIVS had differential impacts in terms of food-security and maize production on male- and female-headed households. Systematic differences in the demographic characteristics between the male- and female-headed households were measured mainly by running a t-test for the area of total land owned, area of cultivable land owned, and literacy levels.
To measure the differential impacts of NAIVS on maize harvest, I used household data since the listing had insufficient observations for female-headed households needed to make comparisons. To check if the outcomes were different, the following factors were investigated using a t-test:

a. Quantity of maize harvested
b. Quantity of harvested maize consumed by household
c. Quantity given in kind as school fees
d. Quantity that was sold
e. Total value of sales
f. Per unit value

To investigate the heterogeneous impact on household food-security, I explored descriptive statistics. The number of meals consumed on an average per day in the last month and during the lean period was one such indicator used to analyze differential outcomes for male- and female-headed households. These indicators also notified us – of the purpose of the programme -- if there were any different impacts of the programme for male- and female-headed households.

3.4 Hypothesis 4: NAIVS positively impacted female-headed households

This section aims at measuring the impact of programme on the female-headed households in particular, the data population. The data used for the analysis is a separate dataset collected by REPOA in collaboration with the University of California, Berkeley with support from 3ie. To gauge any differences between the female beneficiary households and female non-beneficiary households, this gender module dataset is merged with the Household data using a Unique Identification Number to check for systematic differences in – area of land owned, area of cultivable land owned, literacy levels, age, education levels and dwelling ownership status. These parameters are measured using a t-test.

After this was done, I checked the programme for any influences on food-security, entrepreneurship, spending preferences of women, access to health services and intimate partner relationships. This was largely done using descriptive statistics and any causal link between the programme and the variable of interest proved hard to establish. It is recommended that further research be done in this area to investigate a causal link between agricultural input subsidies and these parameters for female-headed households.

The log frame table below further describes the indicators and methods used for each outcome of interest.

Log frame of Indicators and Methods used (Figure 1.2)

Research Objective	Indicators used	Method used for analyses
1. Household Food Security	1. Dummy Variable: How often did you worry that your household would not have enough food in the past 30 days? 2. Control Variables a. Male Household Head b. Literacy level (Some literacy) c. Area of land owned d. Region 3. Beneficiary status (Yes=1)	Multivariate fixed effects regression analysis T-Test
2. Household Food Insecurity	3. Dummy Variable: How often did you worry that your household would not have enough food in the past 30 days? 4. Control Variables e. Male Household Head f. Literacy level (No literacy) g. Area of land owned h. Region 3. Beneficiary status (No=0)	Multivariate fixed effects regression analysis
3. Maize Productivity	Comparison of maize yields with and without vouchers in year 2009/10 and 2010/11	Pre-post Simple Difference
4. Food Security for Female-headed Households	Comparison between beneficiary and non-beneficiary households how many days in the past 30 days did they or someone in their family went to bed hungry'	Two sample T-Test Simple Regression
5. Financial spending (Female-headed Households)	Preferential spending of beneficiaries compared to non-beneficiaries on the following: - Education - Food - Birth Control & Family	T-Test Simple Regression

	Planning - Small Businesses - Beauty Products	
6. Access to Health services	Specific questions asked pertaining to health services	Descriptive statistics

4. Rationale for the methods used and the limitations

The methods used for these analyses have their strengths and limitations as discussed below.

4.1 Multivariate Regression Analysis for Food Security

A multivariate regression analysis is where the outcome of interest is measured for the treatment group (those who received the NAIVS intervention) and compared to the control group (those who did not receive the intervention), when other variables that might have the possibility of affecting the outcome (y) are 'controlled' for in the equation. The regression model for food security-analysis is inspired from the model specification used by Andrew Doward (2013) for the analysis of impact of Agricultural Input Subsidy on food-security in Malawi. The control variables used in my specification, however, are different and account for variables that could most likely affect the outcome of interest in the case of Tanzania i.e. difference between the total areas of land owned, levels of literacy, having a male Household Head and the regional variation. These control variables were selected based on baseline differences between the beneficiaries and the non-beneficiaries. I used fixed effects regression since this was a panel data.

One of the drawbacks of controlling for several variables in a single equation was the 'Simpson's Paradox' wherein, inclusion of another variable could affect /change the direct relationship between the other dependent and independent variables (Judea, 2011).

Yet another drawback was that it assumed that the other possible control variables excluded from the equation did not bias the outcome of interest being measured -- these could be both, the unobservable or the variables that were measured yet excluded from the equation. It was not possible to account for all possible control variables in the analysis (Gertler, 2011).

4.2 Simple Difference in Means for Maize Productivity

This was mainly the measure of difference in the means before and after intervention for both, the treatment group and the control group. In this case, the mean of maize yield (outcome of interest) for beneficiaries (treatment group) and non-beneficiaries (control group) was measured and compared before and after the commencement of the intervention.

This Methodology was limited in that it assumed that people in the treatment group were identical to those in the control group and were equally likely to participate in the programme/intervention (J-PAL, MIT, 2012). While establishing any causality with this method is difficult and error-prone, the productivity in maize yields was cross-checked by the perception of the programme's participants about the yields. However, the main constraint was that the perceptions of the participants and non-participants were not compared.

4.3 T-Tests and Descriptive statistics for Heterogeneous impacts of NAIVS

Testing the hypothesis for differential impacts on male- and female-headed households was measured by whether these groups had any different mean values for outcomes, such as, maize harvest, total output sold and income levels. In this analysis, the sample being large and the distribution being normal, an independent t-test was less likely to be error-prone, but it was constrained by the fact that while a relationship (positive, negative or nil) between two variables could be established, it still did not necessarily point towards any causality.

4.4 T-Test and Regression analysis for Differential impacts on Female-headed Households

A t-test provides a good medium to compare the means in each category and determine its statistical significance, and if, there is a positive relationship between the two variables of analysis when trying to examine the differences between the beneficiary and non-beneficiary households. The

regression analysis is used to analyze the impact on food-security and examine any causality between the programme and whether female-headed households did experience food-security. The limitation of this method is that there might be other variables or factors affecting the outcome, which are not accounted for in the regression equation, since only the beneficiary status is regressed on the outcome (food secure), with region-fixed effects.
Despite the limitations of the methods used, the results discussed in the next chapter provide key insights on the impacts.

Section 2

Results and Discussion

Part A

Implementation of the Programme; NAIVS

Any examination of the programme's impact or attributing causal links is based on the assumption that the programme was implemented as intended. Thus, it is essential to check if there were implementation issues and whether or not the programme criteria were followed.
Baseline characteristics of the beneficiary and non-beneficiary households are compared in order to check for systematic differences between the two groups. Only if there are no major differences, can any impact be attributed to the programme.

Table 1.1 Demographic comparisons of Beneficiaries and Non-Beneficiaries

Group	Indicator	Observations	Mean	Std.Error	P value	Significant?
Beneficiary	Gender of HH	953	1.459601	.0161521		
Non-Beneficiary	Gender of HH	874	1.5	.0169224		
Combined	Gender of HH	1827	1.478927	0116905	0.0843*	Yes 10% Level
Beneficiary	Owns a House	953	.9454355	.0073613		
Non-Beneficiary	Owns a House	874	.9382151	.0081486		
Combined	Owns a House	1827	.9419814	.0054708	0.5099	No
Beneficiary	Total Area of Land Owned	953	5.275656	.3565799		
Non-Beneficiary	Total Area of Land Owned	874	3.955721	.2130696		
Combined	Total Area of Land Owned	1827	4.644226	.2126019	0.001***	Yes 1% Level
Beneficiary	Cultivable Land owned	953	4.405876	.2602297		
Non-Beneficiary	Cultivable Land owned	874	3.551487	.1849649		
Combined	Cultivable Land owned	1827	3.997154	.1622985	0.0085***	Yes 1% Level
Beneficiary	Main source of Lighting	953	4.581322	.0416779		

	(4=Biogas; 5=Lamp Oil)					
Non-Beneficiary	Main source of Lighting	874	4.737986	.0377443		
Combined	Main source of Lighting	1827	4.656267	.0283121	0.0057***	Yes 1% Level

Source: Household Data (REPOA)

Table 2: Demographic characteristics of the Beneficiary Households

SURVEY:	**Household**		**Listing**	
Sample size:	1913		2,720	
Housing Construction:				
Outside Walls (burnt bricks / cement)	208	10.87%	1,803	66%
Outside Walls (Stone)	1121	58.59%		
Roof (corrugated tin)	1443	75.43%	1,825	67%
Floor (cement concrete)	679	60.57%	764	28%
Total Landholdings (acres mean):	4.7	0.24%	2,716	4.9
Total Cultivable land owned (acres mean)	3.98	0.20%		
Sex of Respondent (male):	1,035	53.82%	2,040	75%
Age of respondent (mean)	47	2.45%	-	-
Marital Status:				
Married (monogamous)	1062	55%	1,968	72%
Married (polygamous)	121	6.38%	168	6%
Informal union	39	2%	99	4%
Divorced	11	0.58%	18	1%
Separated	148	7.80%	122	4%
Widowed	414	21.81%	235	9%
Never married	103	5.43%	106	4%
Literacy (read & write any lang):	1475	77.71%	-	-
Education Level:				
Standard 1 – 3	167	8.80%	-	-
Standard 4 – 6	30	1.58%	-	-
Standard 8-7	1159	61.09%	-	-
Form I – III	33	1.73%	-	-
Form IV – VI	93	4.90%	-	-
No education	320	16.86%	-	-
Main Activity:				
Paid employee	53	2.79%	75	3%
Self-employed (non-agric)	51	2%	30	1%
Works on own farm	1,366	71%	1,460	54%

Source: Baseline data report (REPOA, 2012)

Given the summary statistics in Table 1 and Table 2, the beneficiaries were wealthier than the non-beneficiaries in terms of area of land owned, area of cultivable land owned and source of lighting. These differences were statistically significant. Being a beneficiary, and a male-head of the

household was significant at the 10% level. It was therefore, important to note these differences in further analyses.
Before discussing the general impact of the programme on small-scale farmers in Tanzania, it is essential to see how well the programme was implemented in terms of targeting, awareness and redemption of vouchers.

Key Findings: Implementation of NAIVS

a. Awareness

Awareness has been key to the success of many agricultural input initiatives (V. Kelly et al., 2003). It is very critical to creating an effective demand for agricultural inputs and speeding up input adoption. Levels of awareness have been factors that can increase the likelihood of *elite capture* of vouchers (Bardhan&Mookherjee, 2000). The key findings suggest a need to focus on specific criteria and objective awareness of the programme. The NAIVS campaigns attempted at facilitating small-scale farmers' awareness of the scheme. Ninety-three per cent of the total households surveyed were aware of a programme that provided vouchers for farmers to buy fertilizer and seeds, however, almost 50% of the respondents were unaware of the eligibility criteria, indicating the absence of informed participation, which was a crucial aspect of the programme's overall objectives (Malhotra, 2013).

Low awareness about the exit mechanism of the input subsidy

A related risk for the viability of the programme outcome was the expectation for the input subsidy to continue indefinitely (World Bank Report No: 48549-TZ). While an eligible small-scale farmer was to receive vouchers for three years, nearly half of the surveyed respondents did not know about this. Thus, only 28% were aware of this fact while 19% believed that they were supposed to receive vouchers each year in continuation. Half the farmers did not understand the programme's exact exit strategy, which could potentially result in farmers being unprepared to purchase non-subsidized agricultural inputs in the fourth year or the year that followed, probably defeating a crucial objective of the programme (Malhotra, 2013).

b. Administrative bottlenecks

One of the prime institutions at the village level responsible for administering the programme was the VVC – Village Voucher Committee (comprising six farmers in total -- three women and three men elected by the village assembly). Apart from being responsible for identifying beneficiaries, the VVC also watched over the distribution and monitored the use and redemption of vouchers. The key findings below point to particular administrative bottlenecks that had implications for efficient service delivery of the programme.

Land criteria for beneficiary selection not followed completely

The input subsidy was aimed at small-scale farmers, i.e. farmers who owned no more than a hectare (or 2.5acres) of land (World Bank Report No: 48549-TZ). However, one in every four beneficiaries owned at least one plot that was more than a hectare. Therefore, it may be questioned if the selection procedure was unbiased, as the land was a crucial criterion in identifying the scale of a farmer (Malhotra, 2013).

Village Voucher Committee officials did not ask the farmers if they could afford the required top-up

One of the main eligibility criteria was that the farmer should be 'willing and able' to co-finance half the cost of the voucher inputs (World Bank Report No: 48549-TZ). Nevertheless, 60% of the beneficiary households were not consulted and the VVCs/village officials/hamlets did not ask if they would be able to afford the cost of the top-up. (Malhotra, 2013).

Lack of physical possession of vouchers coupled with inability to purchase the inputs

Regulation of delivery was a key component for efficient agricultural service (Smith, 2002). In the context of NAIVS, the nature and timing of the delivery of the input vouchers was essential to achieve the desired outcome of increased production (World Bank Report No: 48549-TZ). A third of the respondents did not physically possess vouchers, and a small portion of the respondents (11%) received a paper certificate in lieu of the vouchers when these were delayed in the 2011-12 season. Out of those that received paper certificates, nearly half were unable to purchase the subsidized inputs, as the paper certificates were not accepted by the agro-dealer (Malhotra, 2013).

Weak agricultural extension service

Farmers entering the scheme had to be willing to utilize the inputs following the recommendations provided by the extension service. However, only a minority of the surveyed beneficiaries (12%) were advised by the extension service. In general, though the demand for such advice was high: 75% of the surveyed respondents needed it, only 12% received it. The top two sources of such advice were the government and the farmer peer group, and a majority of the recipients of the advice claimed putting the advice into practice (Malhotra, 2013).

c. Elite capture of Vouchers and Targeting

Several studies imply that with the decentralization of subsidy vouchers, there was often a tendency of the elite to capture the benefits. The assumption was that farmers more connected to the political class (in this case the Village Hamlet, VEO, VVC Members) were more likely to get the vouchers than others. Here, we first checked the descriptive statistics and t-tests for whether the beneficiaries were more connected to the political elite in their respective villages.

Table 1.3: Political Networks*

	Beneficiaries	**Non-Beneficiaries**
Hamlet Chairperson:		
Knows	98%	98%
Socializes regularly with	67%	67%
Related to	18%	15%
Is hamlet chairperson	2%	1%
VEO:		
Knows	94%	86%
Socializes regularly with	44%	53%
Related to	2%	2%
Is VEO	0.3%	0.0%
VVC member:		
Knows	80%	37%
Socializes regularly with	41%	34%
Related to	7%	8%
Is VVC member	0.5%	0.0%
*Source: Baseline Data, REPOA (2012)		

Respondents who held any of the positions or were related by blood to any position-holders were considered "related". Those who knew the position-holders and had regular social contact with them (defined as having meals in each other's homes) were considered "connected" (REPOA, 2012). As reported in Table 1.2, the results of being connected with the political class do not seem very different for either the beneficiaries or the non-beneficiaries (REPOA, 2012).

However, on running a regression analysis -- with beneficiary status as the dependent variable -- on a variable that defined having regular social interaction with the hamlet's chairperson, executive officer or VVC, did reveal that the farmers who interacted more frequently with the Hamlet and the Village Executive, got the vouchers and this was statistically significant. Having regular social interaction was significant at 10% levels for the hamlet chairperson and at 5% levels for the village executive.

The above findings raise issues about the programme's targets. How well a programme was targeted for the intended beneficiaries was one of the yardsticks to measure the efficacy of the scheme. A study of the Malawi Input Subsidy in 2010 found that the poor households and households with an elderly person were less likely to receive fertilizer subsidy (Chirwa et al., 2010). The results showed that people did not prefer lottery as a target method, though it was used in villages of Arusha. An Albanian study on cash transfers noted that targeting criteria was more efficient when the local authorities had to decide the beneficiaries (Alderman, 2002). In Malawi, the resources were also better utilized when the targets were zeroed in through self-selection instead of a lottery (Jack, 2013). In the context of NAIVS, the programme was not pro-poor or intended to target the poor households. It aimed at improving the macro-level food production (Mccoy, 2014), however, it did intend to target 'small-scale' farmers and women-headed households, which was parameter critical parameter in measuring the programme target methods.

PART B

Impact on Food Security

One of the primary objectives of agricultural subsidies is to ensure food security at the household level. I used the Household data from year 2011-12 to investigate the impact of NAIVS on household food-security. Households were asked a few questions on food security among which was, "How often did you worry that your household would not have enough food in the past 30 days?" A dummy variable called Food-secure was created and set as equal to 1 if the household a) never worried b) rarely worried i.e. once or twice in the past 30 days.
To measure food-security, I ran a fixed effects regression (controlling for the region) on the dependent variable Food-secure on the dummy variable BeneficiaryA1=1 if the household received NAIVS vouchers, and BeneficiaryA2=1 if the household did not receive the NAIVS vouchers. I controlled for variables, such as, Male household head, if the respondent knew how to read and write (both) i.e. Literacy, and total area of land owned.

$$xi: \gamma = \alpha + b_1X_1 + b_2X_{2...E}$$

(1)Food security = Beneficiary (1) + Male Household Head + Literacy + Primary Education+ Total area of land owned+ i.region

On regressing, the dependent variable 'Food-secure' on independent variables -- if the household was a beneficiary, the total area of land owned, literacy level (read and write both) and if it was a male household head with fixed-effects of the region, I found that being a beneficiary positively impacted household food-security. This was statistically significant at the 5% level.
Knowing how to read and write also positively impacted the level of food security in a household, literacy was significant at the 1% level. However, having a male household head and area of land owned did not significantly affect food-security.

Table 1.4 Regression 1, Food Security

Source	**SS**	**DF**	**MS**	**Number of obs =**
Model	30.600195	11	2.78183591	F (11, 1682) = 17.22
Residual	271.76108	1682	.161570202	Prob> F = 0.0000
Total	302.361275	1693	.178594965	R-squared = 0.1012
				Adj R-squared = 0.0933
				Root MSE =-.40196
Foodsecure	**Coeff.**	**Std.Err**	**t**	**P>|t|**
Beneficiary	.045327	.0197498	2.30	0.022
Literacy	.105808	.0248455	4.26	0.000
Male HH	-.0076266	.0203957	-0.37	0.709
Area of Land owned	.0008752	.0011403	0.77	0.443

To investigate the reverse, I examined the dependent variable -- household food-insecurity as well. I created another dummy variable -- Food-insecure for the question "How often did you worry that

your household would not have enough food in the past 30 days?" If the household answered a) worried sometimes i.e. three to ten times in the past 30 days or b) worried often i.e. more than 10 times in the past 30 days, this dependent variable was then regressed on independent variables, such as, being a Non-beneficiary, having a Male Household Head, not knowing how to read and write (no literacy) and area of land owned.

(2) Household Food Insecurity = Non-Beneficiary + low Literacy + Male Household Head + total area of land owned + Region

On running a fixed-effects regression on the dummy variable -- food-insecurity on the selected independent variables, I found that being a non-beneficiary was positively related with household food-insecurity and this was statistically significant at the 5% level. Not knowing how to read or write (no literacy at all) was also positively related with household food-insecurity. This was statistically significant at 1% level. Having a male household head, or area of land owned were not statistically significant factors for food-insecurity.

Table 1.5 Regression 2, Food Insecurity

Source	**SS**	**DF**	**MS**	**Number of obs = 1694**
Model	30.659612	11	2.78723745	F (11, 1682) = 17.25
Residual	271.701663	1682	.161534877	Prob> F = 0.0000
Total	302.361275	1693	.178594965	R-squared = 0.1014
				Adj R-squared = 0.0955
				Root MSE =.40191
Foodinsecure	**Coeff.**	**Std.Err**	**t**	**P>|t|**
Non-Beneficiary	.0442816	.0197728	2.24	0.025
No Literacy	.1119824	.0260299	4.30	0.000
Male HH	.0060721	.0202941	0.30	0.765
Area of Land owned	-.0009403	.0011403	0.72	0.610

To further analyse the impact of the National Agricultural Input Subsidy on food-security, I examined more variables. Households were questioned on the number of meals they /their household members consumed on an average per day in the a) last thirty days and b) in the typical month in the lean period. I ran a t-test to examine the differences between beneficiary and non-beneficiary households. NAIVS Beneficiaries consumed more meals on average per day, and the differences were statistically significant at 1% level (P value: 0.0007). Even during the lean period, beneficiary households consumed more meals as compared to non-beneficiary households, and the difference was statistically significant at 1% level.

Table 1.5 Average Meals consumed; Food Security T-Test

1. Meals consumed per day	Group	Obs	Mean	T-Test P-value	Std.Error
a) In the past 30	Beneficiary	887	2.80	0.0007	.0153807

days					
	Non Beneficiary	831	2.67	0.0007	.0175287
b) In the lean period month	Beneficiary	887	2.40	0.0005	.0213587
	Non Beneficiary	831	2.28	0.0005	.0233564
2. How many days per month did you/someone in household go to bed hungry	Group	Obs	Mean	T-test P-value	Std.Error
	Beneficiary	887	.8218715	0.0529	.094188
	Non Beneficiary	831	1.102286	0.0529	.1107001

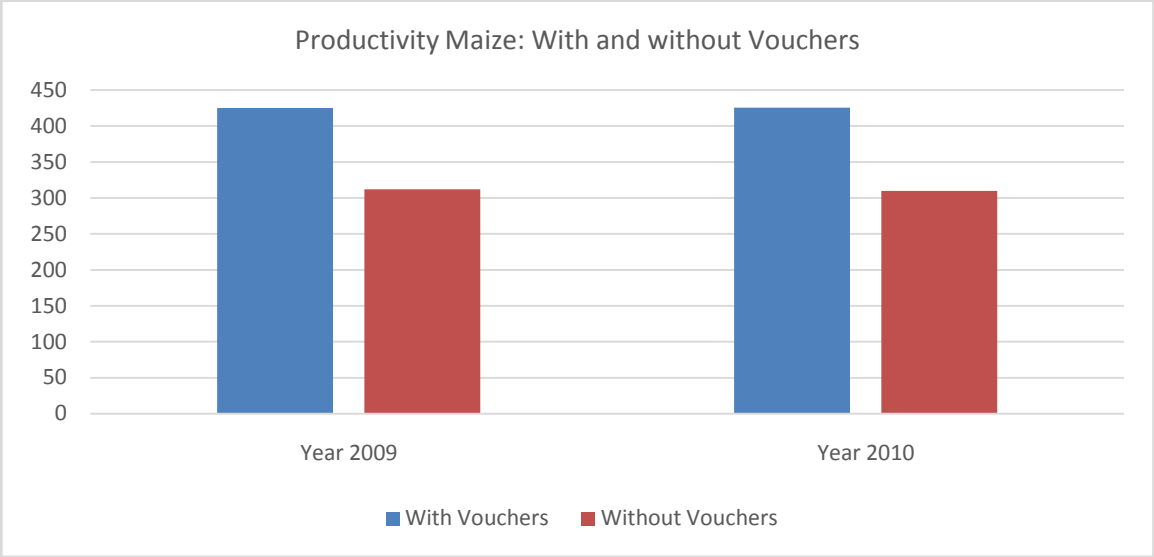
In another linear regression between food-security as the dependent variable and quantity of fertilizer (urea) used on the land as the independent variable, I found that there was a significant positive relation between the two. Thus, the amount of urea fertilizer used did impact food-security of households. It may be concluded that beneficiary households were relatively more food-secure than the non-beneficiary households.
The results did determine some impact on household food-security; however, there were baseline socio-economic differences (even though key differences were controlled for in the equation) between the beneficiaries and non-beneficiaries. The impact of the programme was determined as being difficult. The evaluation report from 3ie found no significant impact of the programme on household food-security; however, the report only focused on villages where lottery resorted to, to determine the targets. The Malawi study on input subsidies however, detected significant impact on household food-security (Dorward, 2012).

Maize Productivity

"*Maize is the staple food of choice for the majority of Tanzanians. For many households, it forms the basis of the main family meal. Around 65 percent of Tanzania's households grow maize*[1]*; these include a large proportion of Tanzania's poorest households. So, it is a crop that has a double impact on the poor, through production and consumption*" (Mahdi, 2009)
Maize is a staple crop in Tanzania and indispensable for food-security. I used the Listing dataset and compared maize produced per acre with and without vouchers to examine the impact of agricultural input subsidies on maize productivity. From the listing dataset, I divided the variable – acres of land in which maize was cultivated by the produce in that season to get the variable Productivity for that particular season.

Productivity = total acres of land on which maize was cultivated / Kgs of Maize produced in (year)

Table 1.6 Maize Productivity with and without Vouchers; 2009/10-2010/11



The average maize yield for beneficiary households was higher than the one for non-beneficiaries. However, as noted earlier, there were characteristic differences between the beneficiaries and non-beneficiaries. The NAIVS beneficiaries owned more land -- cultivable land, had better sources of lighting, and were wealthier than the non-beneficiaries on average. Thus, higher yields or the quantities harvested could not be solely attributed to the programme itself. Using the household data, we ran a t-test between the total quantities of maize harvested for beneficiaries and non-beneficiaries and found that beneficiaries harvested a higher quantity of maize. The mean for the beneficiaries was 1459kgs whereas, the mean for non-beneficiaries was 685 kgs; this difference was statistically significant at the 1% level. Of the total quantity of maize harvested, beneficiaries' households consumed 30% of the maize harvest and sold 53%. Non-beneficiaries consumed 44% and sold 40% of the harvest. Nearly 74% of the total harvest was sold to a middle-man or a wholesaler suggesting a lack of direct connection with the market for both, beneficiaries and non-beneficiaries.
To check if the input used could have caused improved yields, I ran a t-test to compare the quantity of fertilizer used (urea) among beneficiaries and non-beneficiaries. The former used more quantity of fertilizers than the latter and the difference was statistically significant at 5% level.

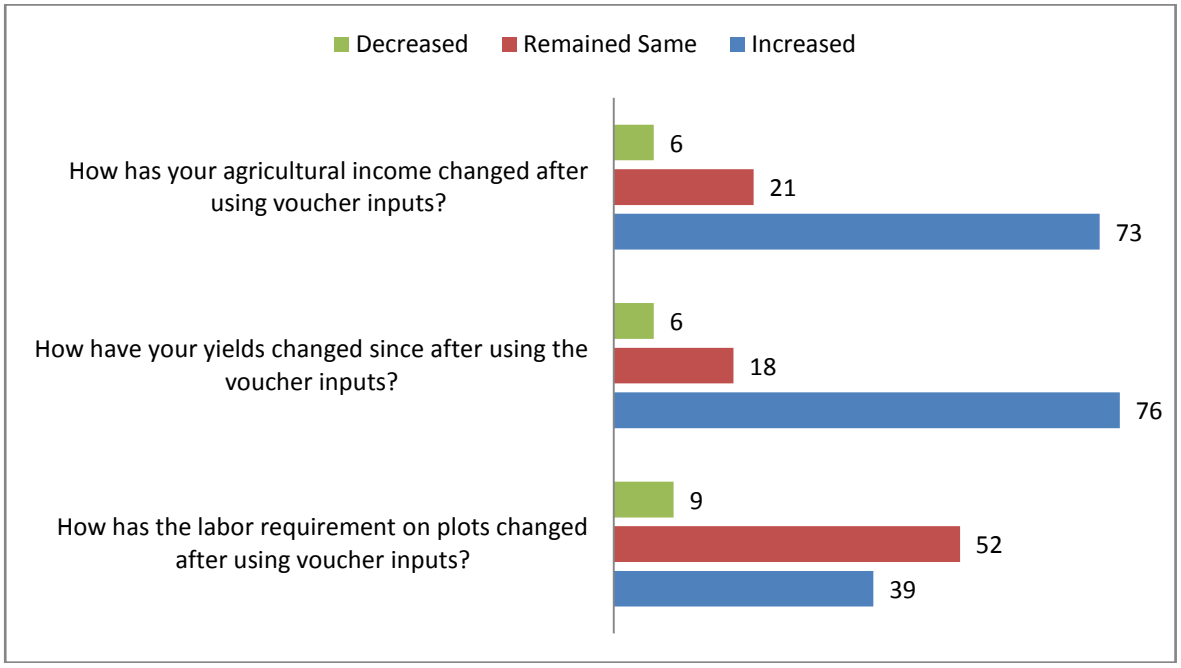
Perceived Outcomes

The perceived impact of the programme on the beneficiaries was consistent with the actual result in terms of yield. Most beneficiaries felt they had higher yields after using the voucher inputs (76%) whereas only 6% said that they had lower yields, while 18% felt that their yields remained the same despite the inputs.
Beneficiaries reported higher incomes post using inputs – a majority of the respondents (73%) felt so whereas 21% of the respondents reported no change in their incomes and only 6% felt that they had lesser agricultural income after using the voucher inputs.

Using the vouchers and applying the inputs did not interfere with the beneficiary's ability to earn income from sources other than agriculture. Out of the total beneficiaries surveyed, only 10% felt that using the vouchers and applying the inputs interfered with their abilities to earn incomes from

non-agricultural sources; while 90% of them felt no constraints on their ability to do so. Of those who reported it did so interfere, 83.5% cited time constraints, whereas 10% cited restraints on credit and only 5% felt that energy was a constraint.

Table 1.7: Perceived Outcomes



While the farmers said they had increased yield, they still faced constraints when marketing their increased output. Of the total respondents surveyed, the agro-dealer network only accounted for 0.6% where farmers sold their output (while the programme focused on agro-dealer training for redeeming the inputs, it could also focus on training them for market output). A majority of the surveyed farmers (46%) sold their crop output to middlemen – which could possibly decrease their profitability further, if farmers were to buy non-subsidized inputs in consecutive years. Thirty per cent sold it to a wholesaler; 21% to retail customers and only 4.6% sold their crops to Cooperatives while only 0.5% handed it to the Government.

Crop production was expected to increase with the introduction of NAIVS. In terms of productivity, the beneficiaries had higher yields than non-beneficiaries -- a result consistent with the 3ie evaluation. The results here indicated that when the targeting criteria were enforced, the intended impact on productivity was not found. In villages holding lottery, less productive farmers or those who could not afford the top-up were selected, whereas in villages where the Village Voucher Committee selected the beneficiaries, there was a significant impact on production. In villages having lottery, technology inputs were shared by the beneficiaries so it was difficult to gauge the intended impact (3ie, 2014). The subsequent section explores the differential impacts of the programme on male- and female-headed households.

PART C

Differential Impacts of NAIVS

To examine the heterogeneous effects of NAIVS on maize harvest – particularly, between male- and female-headed households, I used the household data since the listing data did not have sufficient number of observations for female-headed households. Before checking for maize harvest and household food-security, certain economic baseline characteristics were compared between the

male- and female-headed households for -- a) area of total land owned and b) area of cultivable land owned. The t-test analysis suggested that male-headed households owned more total area of land as well as total area of cultivable land. The difference was statistically significant at the 1% level -- a finding consistent with the existing literature evidence.
Male-headed households were more food-secure as evident when households were questioned, "How many days did you or someone in your household go to bed hungry in the past 30days?" and the t-test between the genders of the Head of the Household variables proved this; the difference was statistically significant at the 1% level. Male-headed households also consumed more meals per day on average during the lean period and differences were statistically significant at the 1% level. Further, when the maize harvest for female- and male-headed households were compared, the analysis suggested that the latter harvested and sold more quantities of maize but mostly to the middle men and in general, had higher incomes. The former harvested relatively lesser quantities but sold more to the retail consumer directly, so got a higher per unit price for their produce. This however, could be attributed to male-headed households selling greater quantities at a lesser per unit price. A higher maize harvest by male-headed households was also likely because they owned more land plus cultivable land as compared to female-headed households. Given that there were systematic differences between the two sub-groups, and to gauge the actual impact on female-headed households; female beneficiary households are compared to female non-beneficiary households in the subsequent part.

Impact on Female-headed Households

This section aims at examining the impact of the agricultural input subsidy on female-headed households and young women in Tanzania. This was a separate module administered by the University of California, Berkeley with support from 3ie. Here, we look at the impact of the programme on food-security, financial spending, health services and relationship power, in-depth. Resources for the impact of agricultural input subsidies on women's access to health, financial spending and intimate relationships are scarce. A total of 859 female-headed households were surveyed, out of which 441 were beneficiaries and 448 were not. The following baseline characteristics of the female-headed households have been compared:
-Age
-Literacy
-Area of Land owned
-Area of cultivable land owned
-Dwelling ownership status

Table 1.8: Differences between Female-headed Households- Beneficiary & Non-Beneficiary

Group	Indicator	Observations	Mean	Std.Error	P value	Significant?
Beneficiary	Age	441	49	.6925037		
Non-Beneficiary	Age	418	53	.7793578		
Combined	Age	859	51	.5241995	0.0001***	Yes 1% Level
Beneficiary	Literacy	441	.7210884	.0213797		
Non-Beneficiary	Literacy	418	.6291866	.0236537		

Combined	Literacy	859	.6763679	.0159725	0.0040***	Yes 1% Level
Beneficiary	Education Level 1= More than primary 0 = Primary Education	425	.2282353	.0203822		
Non-Beneficiary	Education Level	365	.2082192	.021282		
Combined	Education Level	790	.2189873	.0147231	0.4983	No
Beneficiary	Total Area of Land Owned	442	3.207579	.2300702		
Non-Beneficiary	Total Area of Land Owned	420	3.137619	.2156786		
Combined	Total Area of Land Owned	862	3.173492	.1579019	0.8249	No
Beneficiary	Cultivable Land owned	442	2.838009	.2040688		
Non-Beneficiary	Cultivable Land owned	420	2.54119	.106747		
Combined	Cultivable Land owned	862	2.693387	.1168955	0.2046	No
Beneficiary	Own the dwelling you live in	349	1.297994	.029959		
Non-Beneficiary	Own the dwelling you live in	334	1.272455	.030016		
Combined	Own the dwelling you live in	683	1.285505	.0211987	0.5474	No

The above Table indicates the socio-economic characteristics of the beneficiary and non-beneficiary female-headed households and there are no statistically significant differences in terms of wealth -- area of land owned, area of cultivable land owned and the status of dwelling occupancy. However, the beneficiaries are younger than the non-beneficiary female-headed households and this is statistically significant at the 1% levels. The two groups also exhibit differences in the literacy levels -- defined as knowing how to read and write, both. The beneficiary female-headed households seem more literate and the difference is statistically significant at the 1% level.

Entrepreneurship

To check how the programme impacted entrepreneurship and side-job incomes, all respondents were asked if they had taken up side jobs since January 2011, sold some assets or started any small businesses. Of those saying 'yes' (327 in total), 54% were from the beneficiary households.

Respondents were also asked if they had started any new business or expanded existing ones, and 55% of those who did so, belonged to the beneficiary households; besides, the percentage of beneficiary respondents (53%) who had money of their own to decide how best to use, was higher.

Financial Spending preferences

In order to know the spending preferences of the female-headed households, the respondents were asked: If given 10,000 Tanzanian shillings to spend as they wished, how much money would they spend on the following items-- Education, food, beauty products, family planning, investments in business, healthcare for family and the self. We examined the spending preferences of both types of households to spot the potential effect of programme.

Financial Spending preferences T-Test: Female-headed Households

Category	Beneficiaries Treatment	Non-Beneficiaries Control	P-value
Education	Tsh 28596	Tsh 23713	0.0262**
Food	Tsh 20777	Tsh 29004	0.0000***
Beauty Products	Tsh 3442	Tsh 3468	0.9585
Family Planning & Birth Control	Tsh 1892	Tsh 864	0.0352**
Small Business	Tsh 33604	Tsh 30755	0.2436
Healthcare for self Or family	Tsh 11686	Tsh 12194	0.7219

Source: Gender Module Dataset

On performing a t-test on the above set of variables, it was clear that the beneficiary households preferred spending more on education, family planning and birth control; the difference being statistically significant at the 5% and 1% levels, respectively. As analyzed in the previous section, beneficiaries were more food-secure. The spending preference for food also indicated the same -- whereas the non-beneficiary households were more likely to spend on the food. The difference here, was significant at the 1% level suggesting perhaps that beneficiary households were food self-sufficient and hence, did not have to spend more on it.

Health Services

Female-headed households were questioned on their access and barriers to health services. In particular, they were asked: When you are sick or want treatment or medical advice, which of these is a barrier or a problem? Money needed for treatment, getting permission to go, distance to the health facility, cost of transportation, not wanting to go alone, concerns that there might not be a health provider or that the health providers might be unfriendly.

It is interesting to note that more non-beneficiaries' households said that getting money for the treatment was a problem (53%) and nearly 60% of those who felt conversely belonged to the beneficiary households. This difference is statistically significant at the 1% level (p-value 0.0002). On regressing the dummy variable 'Money for treatment' equal to 1, if getting money for treatment was not a problem on Beneficiary status equal to 1, if the respondent was a beneficiary, we found a positive significant relationship between being a beneficiary and not having issues for getting money for seeking medical advice (p-value 0.000 and R-Square 0.0134).

Another crucial fact was that more beneficiary households felt going out alone to seek medical advice was not a problem, whereas 56% of non-beneficiary households replied, it was so. The difference was statistically significant at the 5% levels (p-value 0.0338). On running a fixed-effects regression on dummy variable 'Not wanting to go alone' equal to 1, if the respondent said it was not a problem and the independent variable Beneficiary status was set equal to 1, if the respondent was a beneficiary, controlling for the region, we found that there was a positive significant relationship between being alright to go out alone seeking medical advice or treatment and being a beneficiary (p-value 0.018, R-square 0.0383). A majority of the respondents (80%) felt that not having a female health provider was not a concern, however, 58% of those considering this an issue belonged to the non-beneficiary household (p-value 0.0442).
It is worth noting that 60% of the respondents (for both kinds of households) felt that the distance to the health facility was a barrier. However, there were no differences between the beneficiaries and non-beneficiaries in terms of the barriers to access medical aid in terms of cost of transportation, distance to facility, getting permission to go and knowing where to go.

Food Security

The previous section illustrated that on an average, beneficiary households were more food-secure. Female-headed households were questioned as to "How many days in the past 30 days did you or someone in your family go to bed hungry?" and the value of this variable was set as 1 if the respondent said zero days, and set to 0, if the respondent mentioned days greater than zero. Food-secure households here were thus defined by zero days. A t-test suggested that beneficiary households were food-secure, the difference being statistically significant at 5% levels. By running a fixed-effects regression on 'Food secure' as the dependent variable on the beneficiary status and controlling for the region, it was evident that being a NAIVS beneficiary had a positive significant relationship with being food-secure (p-value 0.042, R-Square 0.0288).

Violence, Autonomy and Decision-making

Female-headed households were asked a few questions about violence and decision-making in their current relationships in order to investigate if there were any systematic differences -- arising out of the programme -- between the beneficiaries and non-beneficiaries, or if being a beneficiary impacted intimate partner violence in any manner. While the data might not be sufficient enough to establish a causal link between the two, descriptive analyses could still suggest overall differences. A majority of the respondents surveyed said that their partner did not threaten, insult or humiliate them. Of the ten respondents who said indicated violence – being slapped, hit, or kicked by their partners -- in the 12 months before the survey, 80% belonged to the non-beneficiary households; and of the 12 respondents forced to perform sexual acts / sexual intercourse against their will by their partners, seven or 58% belonged to the non-beneficiary households. The differences however, were not statistically significant.
Of those respondents who could openly ask their partners to use a condom, 52% belonged to the beneficiary households. Sixty per cent of the respondents did not have to ask for money from their partners before or after having sexual intercourse and belonged to the beneficiary households. However, of the 12 respondents who said they asked for school fees from their partners after or before sexual intercourse, ten belonged to the beneficiary households; the t-test suggested a statistically significant difference in this case (p-value 0.0530). Out of the respondents surveyed, only 17% said they could make a decision regarding contraception use alone, whereas the rest made the decision jointly or had the partner decide for them. In terms of decision-making on spending, 65% felt they could buy or invest in expensive items without their partner's approval, and 66% felt that they had their own money/finances to buy whatever they wanted. There were no significant differences between beneficiary and non-beneficiary households.
The data however, is insufficient to draw any conclusion regarding the effects of the subsidy programme on intimate partner violence and decision-making aspects for female-headed households. This may need more qualitative research and maybe focused group discussions.

Conclusion and Recommendations

Conclusion

On examining the general impact of the NAIVS on small-scale farmers, it is clear that the programme did affect food-security at the household level and the use of urea fertilizer in particular, was positively correlated with household food-security. Literacy also had a significant impact on household food-security and in terms of production, beneficiaries harvested more maize than the non-beneficiaries. Even in terms of productivity, beneficiaries had a higher yield. It is interesting to note that beneficiaries' perceptions about the subsidy positively impacting yields matched the evidence. However, given the baseline differences between the two groups, it cannot be concluded that NAIVS solely impacted the high yields for beneficiaries, as the beneficiary group tended to own more cultivable land and was wealthier than the non-beneficiaries.

As discussed earlier, there were also a few implementation issues, particularly in terms of targets -- where the beneficiaries on an average owned more than 2.5acres of cultivable land and the VVC (Village Voucher Committee) did not comprehensively enquire if farmers would be able to afford the top-up costs for the fertilizers and seeds. On regressing the beneficiary status on variables -- knowing, being related to and having regular social interaction with the VVC, Hamlet Chairperson, or the Village Executive to determine if there was any elite capture of vouchers, I found that each of these had a significant relationship with being a beneficiary, or being offered vouchers.

The data was not sufficient to draw conclusions on the impact of the programme on female-headed households in terms of decision-making, violence and autonomy. However, the programme may have affected preferential spending patterns as beneficiaries were more likely to spend on birth control and education. The female-headed beneficiary households were also more food-secure, but my analysis does not consider dietary diversity of the households.

Recommendations

Given the high budget vested in this subsidy, the Government of Tanzania should aim at measuring the impact and cost-effectiveness of the programme vis-à-vis other policy options available to increase technology and input use among farmers. A randomized evaluation evidence from Kenya suggests that a no-subsidy option with free delivery of output after the harvest impacted technology-adoption by 17%, which was higher than the 50% subsidized option for fertilizers; it was also found that a key determinant in technology-adoption was the farmer's ability to save until the next cropping season (Duflo, Kremer, Robinson, 2007). The impacts of the subsidy on female-headed households should be measured using a triangulated approach, with emphasis on qualitative data collection as well.

While food-security of the households was intended as an impact of NAIVS, the policy-makers ought to also attend to the situation and have a more holistic programme targeting households that are severely food-insecure by considering the food basket and nutritional values.
If the programme is to be scaled-up, the following parameters should be considered -- targeting criteria should be followed well especially with land criteria, targeting female-headed households and more transparency in the beneficiary selection procedure – being maintained so that elite capture of vouchers is factored out; administrative bottlenecks, such as, delayed distribution of vouchers eliminated and more effective solutions, such as, e-vouchers (mobile vouchers) or banking solutions providing credit to farmers implemented to potentially speed up the delivery mechanism. The government and farmers' peer groups will need to be more articulate in providing extension advice. However, there is potential for augmenting these private extension service networks. A majority of the surveyed households reported their need for extension advice. The lack of knowledge of how to utilize the inputs in practice, and about market information support would make it difficult for farmers to adapt to changes in technology.

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