Impacts of a donor-funded extension service on small farmers in the Mutasa district of Zimbabwe

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Abstract

Zimbabwe has a pluralistic agricultural extension system. In addition to the public extension service, donors contract private service providers to deliver a range of extension services in specific project areas. This study focuses on extension services delivered by a local agribusiness firm and funded by USAID in the Mutasa district of Zimbabwe's Manicaland province. The purpose is to assess the impact of these services on household outcomes such as farm income, and perceived benefits such as improved diet, health, child education, savings and access to support services. The study analyses survey data gathered from 94 client and 90 non-client rural households in June 2014. Propensity score matching was used to identify an appropriate control group within the group of non-clients. Descriptive statistics were compared across the control and client groups, and the impact of the extension service on each outcome estimated using two-stage least squares regression with instrumental variables to account for selection bias. The results show that outsourced extension services contributed significantly to household crop income, net crop income and expenditure on farm inputs and services. In addition, clients perceived a range of socio-economic benefits such as improved food security and better access to support networks. The financial costs and benefits of these services will be assessed in a second paper.

Keywords: Agricultural extension, outcomes, treatment model, selection bias, instrumental variables

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1 Introduction

Agricultural extension services typically include capacity development through training, strengthening innovation processes, building linkages between farmers and other agencies, and helping to strengthen farmers' bargaining position through appropriate institutional and organisational development (Sulaiman & Hall, 2002). There is a strong demand for extension services In Zimbabwe where the vast majority (70%) of farmers are small semi-commercial producers (Moyo, 2011). Extension services that provide specialised information may be privately or publicly funded (Birkhaeuser, Evenson & Feder, 1991). The extension system in Zimbabwe is largely funded by the treasury but with supplementary funding from donors for specific agricultural programmes (Saravanan, 2008; Oladele, 2011).

Traditionally, the public component of Zimbabwe's extension system has been delivered by the Department of Agricultural, Technical and Extension (AGRITEX). AGRITEX is the largest public rural intervention agency in Zimbabwe with representatives at the national, provincial, district and village levels (IFPRI, n.d.). Revenue losses resulting from the introduction of Zimbabwe's 'fast track' land reform programme in 2000 (Government of Zimbabwe & FAO, 2011) reduced the level of fiscal support for AGRITEX. Donor funding used to co-finance AGRITEX was withdrawn in response to the government's land reform initiative. This rendered the public extension service ineffective (Gwaradzimba, 2011) and encouraged donors to experiment with outsourcing. In essence, donor money is now being used to fund extension services provided by NGOs and agribusiness firms (Anseeuw, Kapuya & Saruchera, 2012) - a move embraced by many governments to divest themselves of the burden of financing and providing extension (Kidd, Lamers, Ficarelli & Hoffman, 2000).

The main objective of this study is to assess the impact of an outsourced (donor-funded) agricultural extension service on small farmers in the Mutasa district of Zimbabwe's Manicaland province. This topic is important as agriculture is the only source of income and employment for most of Zimbabwe's poor rural households (FAO, 2003). The study is built on

data gathered from farmers selected using a rigorous sampling design, and employs propensity score matching to identify non-clients and clients with similar attributes. The resultant 'control' and 'treatment' groups are compared to identify differences in farm earnings and other quantitative outcomes of outsourced extension services. The impact of 'treatment' on these outcomes is then estimated using two-stage least squares regression with instrumental variables to account for selection bias. The incidence of other socio-economic benefits perceived by clients is also examined.

The next section of this paper reviews the literature on outsourced extension services and the outsourcing model applied in Zimbabwe. Section 3 describes the study area. Section 4 explains the methods used to collect data, and Section 5 presents descriptive statistics computed for a representative sample of households. Section 6 combines propensity score matching, univariate tests and regression analysis to estimate the impact of outsourced extension services on farm earnings and other household outcomes. Section 7 examines the incidence of socio-economic benefits perceived by clients. The paper ends with conclusions and recommendations.

2 Outsourced extension services

In agricultural extension, outsourcing is a way of contracting private service providers (including private sector firms, NGOs and farmers' organisations) to deliver information and services characterised largely as public goods (Heemskerk, Nederlof & Wennick, 2008). These service providers are often paid from both public and donor funds. Rivera and Alex (2002) contend that outsourcing is a useful strategy for public sector extension systems. Potential benefits of outsourcing highlighted by Griffith and Figgis (1997) include cost savings; increased accountability of service providers through contract specifications and performance measurement; better work and management practices; wider access to skills, knowledge and technology; more efficient use of capital and equipment; better service quality; greater flexibility in services; and local industry development. However, the same authors point out that outsourcing government services can also present challenges. These may include reduced accountability of government for the quality and quantity of contracted services, and collusive tendering or other tendering problems.

2.1 Outsourced extension services in Zimbabwe

Outsourcing agricultural extension services is a relatively new concept in Zimbabwe. Following the 2008 food price crisis, donors such as the US Agency for International development (USAID), European Commission (EC), United Nations Food and Agricultural Organisation (FAO) and Stichting Nederlandse Vrijwilligers (SNV) started experimenting with outsourcing projects. NGOs (both local and international) and private companies were contracted to deliver agricultural extension services in specific parts of Zimbabwe. These services included training in improved livestock and crop farming methods, the introduction of new technologies, and efforts to link small farmers to both input and output markets (Anseeuw et al, 2012).

Outsourced extension services are usually donor-driven in Zimbabwe because most donors stopped channelling funds through the Treasury in 2002 following a series of government-orchestrated land grabs (Anseeuw et al, 2012). Donors contract private service providers and monitor their performance (Anseeuw et al, 2012). This differs from the approach adopted in Mozambique (where private service providers are contracted by the government) but does not imply a lack of collaboration with, or accountability to, the Zimbabwean government.

Outsourced extension services supplement the public extension service delivered by AGRITEX which is generally considered to be ineffective owing to a shortage of vehicles and qualified staff (Hanyani-Mlambo, 2002; Saravanan, 2008). Complementarity between the public and donor-funded extension services is unlikely except in the sense that AGRITEX staff may improve their skills by taking advantage of training sessions hosted by private service providers. Impacts attributed to the provision of outsourced extension services are therefore unlikely to have their origins in the public extension service.

Although there are several donor-funded projects operating in Zimbabwe that provide outsourced extension services, this study examined only one project funded by USAID. The study area was confined to the Mutasa district in Zimbabwe's Manicaland province where outsourced extension services are well established and private service providers are actively recruiting new farmer clients. The project is managed by a private US based company, Fintrac

Inc. The company contracts several NGO's and agribusiness firms to service different parts of its programme target area. The study area is serviced by Favco, a local company that processes fruit and vegetables.

3 The study area

Primary data used in this analysis were gathered from May to July 2014 in the Honde Valley, an area of 500km^2 located in the Mutasa district (Mushunje, 2005). Agriculture is the main economic activity in this eastern region. Annual rainfall averages 850-1000mm, but is restricted largely to the summer months from October to April. Honde Valley is hot and humid with summer temperatures reaching 30 degrees centigrade. Some farmers irrigate crops using gravity irrigation (Development Technology Unit, 1991). The topography ranges from gentle to steep undulating slopes. The Valley is 100km north-east of Mutare, the fourth largest city in Zimbabwe (Mushunje, 2005).

Crops grown include maize, bananas, coffee, tea, tubers and legumes (Mtisi, 2003 & Mushunje, 2005). Approximately 600 of the smallholders farming in the study site use the agricultural extension services provided by a private firm under contract to a foreign donor. These services include training and advice on farming practices (especially bananas and subsistence food crops), loans for seasonal farm inputs, and help accessing markets.

4 Data collection

Two sample surveys were conducted between April and June 2014. The first was a representative sample of all households in the study area. A two-stage cluster sampling method was used to select these households. At the first stage of sampling, two of the five villages (primary stage units or PSUs) in the study area were selected with probability proportionate to an estimate of their size. These estimates were based on a physical count of households (secondary stage units or SSUs) in each village. Households in each of the selected villages were then listed and a simple random sample drawn from each list using a constant sampling fraction (20%). This approach produces a self-weighting sample that can be analysed

as if it were a simple random sample. A total of 152 households were surveyed, representing almost 13% of the estimated 1177 households in the study area.

The second survey was a census survey of all 'new' clients serviced by the private firm in the study site. New clients were defined as those smallholders who, with the firm's assistance, planted tissue culture banana seedlings in 2012 to harvest an improved banana crop between January and June 2014. A total of 32 new clients were surveyed (N_{wc}=32). The samples together yielded 184 respondents. Of these, 94 were households that had been serviced by the firm (including the 32 'new' clients) and 90 were non-clients, i.e. n_c=94 and n_{nc}=90.

A uniform and structured questionnaire was administered in personal interviews with the *de facto* head of each sample household and with all 'new' project clients. The questionnaire gathered information on, *inter alia*: household characteristics and farm characteristics; farm enterprises, seasonal input purchases, and income from products sold in the 2013/14 season; use of advisory, market and other services provided by the private firm and the season in which each of these services were first used by the household.

5 Descriptive statistics for the household sample

The descriptive statistics presented in the following sections were computed from data gathered in the household sample survey (n_h=152) and therefore describe an average household in the study area.

5.1 Household demographics

Table 1 presents the mean value of variables measuring household demographics. Very few adults work off-farm. This reflects the relative importance of farming as a livelihood. The virtual absence of off-farm wage employment is also evident in the high proportion of male-headed households (86%). This contrasts with results from other studies of smallholders in parts of Southern Africa where men become migrant workers in towns and cities (Fenwick & Lyne, 1999; Kassie, Erenstein, Mwangi, La Rovere, Setimela, & Langyintuo, 2012). Although household heads are relatively young (46.6 years) and reasonably well educated (7.5 years of

schooling), they have acquired substantial experience as farmers (13 years). Household composition is similar to that reported in other studies of Zimbabwean smallholders (Mushunje, 2005; ZimVac, 2013).

Table 1 Household demographics in the study area, 2014 (n_h = 152)

Variables	**Mean**	**Standard error**
Size of the household (persons)	5.3	0.24
Number of females	2.9	0.15
Number of males	2.5	0.14
Number of children (≤15 years)	2.3	0.15
Number of adults (16-65 years)	2.8	0.14
Number of pensioners (>65 years)	0.3	0.04
Number of school children	1.6	0.10
Number of adults working on-farm	2.6	0.15
Number of adults working off-farm	0.4	0.08
Age of the *de facto* head of the household (years)	46.6	1.22
Formal schooling completed by the *de facto* head of household (years)	7.5	0.25
Farming experience acquired by the *de facto* head of household (years)	13.0	1.03
Households with a male head (%)	86.0	3.00
Households with a male head responsible for farm management (%)	69.0	4.00

Source: Household survey, 2014

5.2 Farming operations

Table 2 summarises information about household farming operations including annual cash revenue from crop, fruit and livestock sales. These estimates are based largely on recall although many respondents were able to produce receipts and invoices to support their estimates of sales and expenditure. Bananas are by far the most important cash crop, accounting for 75% of farm cash earnings. Many authors view a shift from subsistence staples to high value cash crops (such as bananas) as essential for the improvement of rural livelihoods (Jayne, Yamano, Nyoro & Awuor, 2001; Davis, 2006; Fan, Brzeska, Keyser & Halsema, 2013). Maize accounts for more land than any other crop but is grown largely for

subsistence purposes (Kassie et al, 2012) and generates only 5% of farm cash earnings. The intensive nature of farming in the study area is reflected in low cattle numbers.

Table 2 Household farming enterprises in the study area, 2013/14 (n_h = 152)

Variables	**Mean**	**Standard error**
Revenue from maize, legumes, tubers, vegetables and coffee (US$)	169.17	19.38
Revenue from maize (US$)	38.77	6.00
Revenue from bananas (US$)	645.10	99.34
Revenue from avocados (US$)	34.92	4.49
Revenue from livestock (cattle, goats, chickens & pigs) (US$)	22.95	6.20
Revenue from cattle (US$)	3.95	2.93
Revenue from goats (US$)	6.78	2.02
Total revenue from farming operations (US$)	864.66	100.16
Expenditure on farming inputs, labour and contractor services (US$)	286.41	35.17
Total area cultivated (hectares)	1.13	0.16
Area planted to maize (hectares)	0.48	0.03
Area planted to bananas (hectares)	0.45	0.04
Number of fruit trees	13.48	0.98
Number of cattle	0.78	0.20
Number of goats	2.86	0.23

Source: Household survey, 2014

5.3 Asset ownership

Table 3 presents the mean value of variables measuring household asset ownership. Livestock (especially cattle) account for the largest share of the estimated (local) market value of assets listed in Table 3. In Southern Africa, smallholders keep cattle largely as a store of wealth (Doran et al, 1979; Bote, Mago, & Hofisi, 2014). Irrigation equipment also accounts for a large share of household asset value. The vast majority of households in the study area have their own gravitational irrigation systems.

Table 3 Household asset and wealth ownership in the study area, 2014 (n_h = 152)

Variables	Mean	Standard error
Value of livestock (cattle, goats, pigs and chickens) (US$)	421.76	70.49
Value of cattle (US$)	253.32	67.91
Value of goats (US$)	96.95	8.37
Value of farm improvements (e.g. fencing & irrigation) (US$)	253.94	35.36
Value of irrigation equipment (US$)	181.36	27.19
Value of farm moveable assets (e.g. ox plough and hoes) (US$)	75.27	7.00
Value of household moveable assets (e.g. tv & generator) (US$)	28.40	5.70
Total value of household and farm assets (US$)	779.37	95.39

Source: Household survey, 2014

6 The impact of extension services

To assess the impact of a project in the absence of randomisation, it is important to compare similar households within the client (treatment) and non-client (control) groups (Rosenbaum & Rubin, 1983; Mendola, 2007; Khandker, Koolwal & Samad, 2010). In this study, propensity score matching (PSM) was used to identify a subset of client and non-client households similar in respect of observed family and farm characteristics that were unlikely to vary in the short-term. These variables included the age and gender of the household head; land and labour endowments per adult equivalent[1]; dependants per adult equivalent; per adult equivalent value of farm implements and tools owned before project intervention; and village location. A logit model was estimated to predict the probability (*P*i) that the ith household would use the extension service. Clients were then paired with non-clients that had similar *P*i using a PSM procedure available in SPSS version 22 (Field, 2009). The logistic regression model was statistically significant at the 1% level of probability with a Nagelkerke R^2 of 0.25. Land, labour and dependants were statistically significant and positive determinants of participation. Age was a statistically significant but negative determinant of participation. Unmatched cases were excluded from the treatment and control groups leaving 76 pairs of clients and non-clients.

[1] Adult equivalent = (no. of Adults + 0.5* no. of Children) $^{0.9}$. The power term 0.9 is included to capture size economies (Low, 1986)

Univariate t-tests for the equality of means across these comparable groups of clients and non-clients revealed marked differences in variables measuring project outcomes. Table 4 presents estimates of farm cash income and costs per household and per household adult equivalent. The t-statistics, which test for differences in per adult equivalent group means (to control for differences in household size and composition), highlight large and statistically significant differences in crop revenue, crop net revenue, banana revenue, expenditure on farming inputs and services, and liquidity between client and comparable non-client households.

Table 4 Comparison of mean outcomes (n=152)

Variable	**Treatment (client households n=76)**		**Control (non-client households n=76)**		**t-statistic**[1]
	Per adult equivalent	**Household**	**Per adult equivalent**	**Household**	
Revenue from all crops (US$)	351.31	1154.95	143.74	503.52	3.26 ***
Net revenue all crops (US$)	226.74	762.63	87.62	326.12	3.46 ***
Revenue from bananas (US$)	315.08	1031.61	84.93	323.24	3.64 ***
Cost of inputs & services (US$)	121.90	383.25	56.41	178.66	1.98 **
Revenue from livestock (US$)	6.81	25.92	9.50	19.54	0.40
Liquidity[2] (US$)	494.16	1572.44	251.73	841.87	2.90 ***

1 Tests for differences in per adult equivalent means.
2 Liquidity = revenue from crops, fruit, livestock and livestock products plus the market value of cattle and goats.
***, **, * significant at 1%, 5% and 10% levels of probability respectively.

While the results presented in Table 4 are encouraging, they could be misleading as univariate tests do not account for observed and unobserved variables that affect outcomes but which are not related to the project. While the PSM accounted for observed characteristics that are unlikely to vary in the short-term, it excluded variables like prior investment in fencing and irrigation that could also influence participation. This study made use of the 'general treatment model' to control for the effects of these variables. Following Khandker et al (2010, p.25), the impact of extension services on household outcomes can be measured by estimating the model:

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 X_i + \varepsilon i \quad \ldots\ldots\ldots\ldots (1)$$

where Y_i is an outcome observed for the ith household, T is a variable measuring the level of treatment, X is a vector of observed household and farm characteristics affecting the observed outcome, and ε captures random error and unobserved characteristics influencing the outcome.

Estimating the model by ordinary least squares (OLS) poses a problem because households are not randomly selected for treatment. The project area was selected for physical and climatic conditions that favour agriculture. Within the targeted areas, uptake of project services is voluntary but limited to farming households. Client selection was therefore biased by both observed and unobserved attributes resulting in endogeneity of the treatment variable. This problem can be addressed using two-stage least squares (2SLS) and appropriate instrumental variables (Khandker et al, 2010, pp. 88-90).

In the first stage, the treatment variable (T) is regressed on variables (X) and instruments (Z) that influence participation.

$$T_i=\lambda_0+\lambda_1 Z_i+\lambda_2 X_i+\mu_i \quad \text{..... (2)}$$

Ideally, instruments should be correlated with T but not with factors affecting Y. In this case, the instruments are also uncorrelated with εi. Equation 2 was estimated as a logit model as T was recorded as a binary variable scoring 1 for (n=76) clients in the treatment group and zero for (n=76) non-clients in the control group. Household and farm characteristics included in the PSM were omitted from the estimation of Equation 2, and T was regressed on prior ownership of irrigation equipment, fencing and possession of a mobile phone. Fencing was viewed as an instrumental variable. Households that had fenced their cropland were considered more likely to participate in the project but fencing was not expected to influence the outcomes of outsourced extension services. The estimated logit model was statistically significant at the 1% level of probability, returned a Nagelkerke R^2 of 0.40 and correctly classified 78% of the 152 matched households into their known treatment and control groups. All of the explanatory variables, including the instrument, were statistically significant and positive determinants of treatment.

In the second stage, Y is regressed on Ť, the predicted value of T in Equation 2, and other variables (X) thought to affect project outcomes. Ť excludes the effects of unobserved variables that may influence both participation and outcomes, and thus embodies only exogenous variation in T. Table 5 lists the explanatory variables used to estimate the treatment model for each of six outcome variables, and presents their estimated regression coefficients.

Table 5 Impact of outsourced extension services on household outcomes (n = 152)

Outcome[1] / Explanatory variable	Net revenue from all crops	Revenue from all crops	Revenue from bananas	Inputs & services purchased	Revenue from livestock	Liquidity
Extension service (Ť)	209.60 ***	281.66 ***	320.84 ***	75.16 +	-1.32	293.21 **
Age of farmer	-2.55	-2.95	-2.82	-0.29	0.40	-0.36
Gender (1=male)	-31.67	-73.84	-57.59	-35.86	-8.22	28.41
Education (years)	-2.43	-3.31	-6.51	-0.45	2.06	11.64
Experience (years)	6.41 ***	8.15 ***	6.62 **	2.04	-0.55	17.12 ***
Land/adult equiv. (Ha)	297.98 ***	726.42 ***	683.54 ***	433.59 ***	39.40	975.74 ***
Labour/adult equiv. (#)	-27.25	26.18	37.84	48.91	-15.10	-169.69
Constant	55.63	-52.96	-91.29	-122.63	-11.38	-241.58
F-statistic	5.01 ***	7.80 ***	6.89 ***	7.92 ***	1.96	10.20 ***
Adjusted R^2	0.16	0.24	0.22	0.24	0.04	0.30

1 All outcome variables expressed in US$ per adult equivalent.
***, **, *, + significant at 1%, 5%, 10% and 15% levels of probability respectively.

All of the regression models were statistically significant at the 1% level of probability with the exception of the model estimated for livestock revenue. There was no evidence of severe multicollinearity as most of the explanatory variables, including exposure to the extension service (Ť), had Variance Inflation Factors (VIFs) close to unity. Age and farming experience exhibited modest collinearity with VIFs of 1.5 and 1.8 respectively (Gujarati, 2003, p. 362). The impact of outsourced extension services at household level is measured by B_1, the regression coefficient estimated for Ť. A positive and statistically significant coefficient indicates that the extension service had a positive impact on the outcome. The standard errors of these coefficients were corrected for the two-stage process using the method described by Gujarati (2003, p. 791).

The results presented in Table 5 indicate that outsourced extension services had a positive impact on household crop income, adding per adult equivalent amounts of US$210 to net crop revenue, US$282 to crop revenue and US$293 to household liquidity. Expenditure on crop inputs and services increased by US$75 (t-value=1.45) per adult equivalent. This bodes well for local economic growth. Hendriks and Lyne (2003) report local growth multipliers associated with increased agricultural earnings ranging from 1.71 in Burkina Faso to 2.42 in Senegal. A study in neighbouring Zambia estimated a local growth multiplier of 1.82. The cash gains generated by the extension services investigated in this study were driven largely by commercial production of bananas. There is no evidence that these services increased livestock revenue.

Only two of the household and farm characteristics that influenced participation (namely, the farmer's experience and the household's land endowment) also influenced the outcomes presented in Table 5. Access to land and the efficiency of the land rental market are clearly important issues in promoting farm incomes and local economic growth.

7 Additional benefits perceived by clients

This section considers other benefits perceived by client household (n_c=94). Table 6 presents the incidence of clients that attributed improvements in socio-economic indicators to the outsourced extension services. Clearly, the vast majority of clients perceived improvements in household food security, quality of diet, health, access to support networks, ability to cope with social setbacks, savings and child education. In addition, more than 95% of clients perceived improvements in the quality of their produce (appearance, size and storability) and farm inputs, and in yields achieved for their main cash crops.

Table 6 Additional benefits perceived by clients (n=94)

Outcomes	Clients that perceived an improvement (%)	Standard error
Household food security	95.0	2.30
Quality of family's diet	95.0	2.30
Family health	94.0	2.50
Access to support networks	94.0	2.50
Ability to cope with social setbacks like ill-health and death	89.0	3.20
Household savings	86.0	3.60
Child education	83.0	3.90

Source: Household survey, 2014

8 Conclusion and recommendations

Participation in outsourced extension services was positively influenced by the household's land and labour endowment, investment in irrigation and fencing, and possession of a mobile telephone. It was estimated that these extension services added per adult equivalent amounts of US$282 and US$75 to crop revenue and expenditure on crop inputs and services respectively. The data also suggest that the outsourced extension services produced other socio-economic benefits like improved food quality and food security.

While these findings support the view that agricultural extension services play an important role in raising farm incomes and creating employment opportunities in poor rural areas, they also highlight the need for an efficient land rental market, for rural health and telecommunication services, and for smallholder access to capital to finance improvements like irrigation and fencing. In turn, secure land tenure is required for an efficient land rental market and for investment in improvements. In the absence of these fundamentals, even well-resourced extension services will be less effective and less pro-poor than they should be.

Despite the positive and substantial impact of the outsourced extension services on households, it cannot be concluded that the benefits of these services outweigh their costs. The research was designed to support a cost-benefit analysis and this next step will add value to the study and to the debate on outsourcing extension services in Southern Africa. Ideally,

the study should be replicated in other districts of Zimbabwe, including districts where extension is delivered only by the public agency, AGRITEX.

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