

Analysis of uptake of drip irrigation by smallholder farmers in Zimbabwe: Case study of Mutare District

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Abstract

The use of drip irrigation has the potential to increase yields but uptake by smallholder farmers in Zimbabwe has been low. This study was conducted to determine the factors influencing the adoption of smallholder farmers in Zimbabwe. The study used a quantitative analysis, with the Logit regression model in order to show the relationship between variables in the study. The descriptive characteristics of the smallholder farmers with respect to use and non-use of drip irrigation in crop production were also identified. The study took place in Mutare district. Data was collected from 92 farmers. 46 of the farmers were drip irrigation users whilst 46 of the farmers were none drip irrigation users. Data collection involved the administration of questionnaire. The Logit regression model put to test seven determinants which are income, size of farm, decision making, labour, access to extension service and farming experience. Determinants that were found significant and positively influencing uptake of drip irrigation are farming experience, access to extension and labour. The following determinants were found insignificant to the uptake of drip irrigation; decision making, education, income and size of farm. The less farming experience a farmer has the more likely they are to adopt drip irrigation. Farmers with access to extension services and labor are more likely to adopt drip irrigation. In order to influence adoption and utilisation of drip irrigation it is recommended that, farmers, NGOs and government should engage in the following activities-farmer field schools and support of government extension workers. When NGOs and extension workers distribute drip kits they should assess if the farmer has access to labor for the drip irrigation or recommend alternatives to the manual systems for filling up the drip tanks. Retailers of drip kits can also provide advisory and extension services to ensure increased uptake of the drip irrigation.

Key words: adoption, micro-irrigation, smallholder farmers, Zimbabwe

Resume

L'utilisation de l'irrigation au goutte à goutte a le potentiel d'augmenter les rendements, mais l'adoption par les petits exploitants au Zimbabwe a été faible. Cette étude a été menée pour déterminer les facteurs influençant l'adoption des petits exploitants au Zimbabwe. L'étude a utilisé une analyse quantitative, avec le modèle de régression Logit afin de montrer la relation entre les variables de l'étude. Les caractéristiques descriptives des petits exploitants agricoles en ce qui concerne l'utilisation et la non-utilisation de l'irrigation au goutte-à-goutte dans la production agricole ont également été identifiées. L'étude a eu lieu dans le district de Mutare. Les données ont été collectées auprès de 92 agriculteurs. 46 des

agriculteurs étaient des utilisateurs d'irrigation goutte à goutte tandis que 46 des agriculteurs n'étaient pas des utilisateurs d'irrigation goutte à goutte. La collecte des données a impliqué l'administration du questionnaire. Le modèle de régression Logit a mis à identifier sept déterminants qui sont le revenu, la taille de la ferme, la prise de décision, le travail, l'accès aux services de vulgarisation et l'expérience agricole. L'expérience agricole, l'accès à la vulgarisation et le travail sont des déterminants qui ont été trouvés importants et qui ont eu une influence positive sur l'adoption de l'irrigation au goutte-à-goutte. Les déterminants suivants se sont révélés insignifiants pour le recours à l'irrigation goutte à goutte; prise de décision, éducation, revenu et taille de la ferme. Moins un agriculteur a d'expérience agricole, plus il est susceptible d'adopter l'irrigation goutte à goutte. Les agriculteurs ayant accès aux services de vulgarisation et à la main-d'œuvre sont plus susceptibles d'adopter l'irrigation goutte à goutte. Afin d'influencer l'adoption et l'utilisation de l'irrigation au goutte-à-goutte, il est recommandé que les agriculteurs, les ONG et le gouvernement s'engagent dans les activités suivantes: écoles pratiques d'agriculteurs et soutien des vulgarisateurs gouvernementaux. Lorsque les ONG et les vulgarisateurs distribuent des kits de goutte-à-goutte, ils doivent évaluer si l'agriculteur a accès à la main-d'œuvre pour l'irrigation au goutte-à-goutte ou recommander des alternatives aux systèmes manuels pour remplir les réservoirs de goutte-à-goutte. Les détaillants de kits goutte à goutte peuvent également fournir des services de conseil et de vulgarisation pour assurer une utilisation accrue de l'irrigation goutte à goutte.

Mots-clés: adoption, micro-irrigation, petits agriculteurs, Zimbabwe

Introduction

Globally, irrigated agriculture plays a significant role in food security and livelihood improvements especially in Africa. Climate change has resulted in reduced in precipitation and increased fluctuation of the weather pattern with the attendant adverse effects on dry land rain fed agriculture (Kurukulasuriya and Mendelsohn, 2006). Severe drought and floods are causing malnutrition and increasing children vulnerability to killer diseases such as malaria, diarrhea cholera and dengue fever (UNICEF, 2014). Irrigation development has been recognized globally as an important means of overcoming climate uncertainty with regards to agricultural production and productivity (Alawa *et al.*, 2014). However there is need by farmers to practice some climate adapted measures like drip irrigation. Climate change and its resultant uncertainties in rain fed agriculture makes investments in water storage increasingly critical (Mongi *et al.*, 2010). That makes irrigation in Zimbabwe an important option for the achievement of food security and poverty alleviation especially in this era of worldwide food, fuel and financial crises.

Despite the benefits and significance of drip irrigation to farmer's lifestyle, drip irrigation is not welcomed by smallholder farmers in Zimbabwe. In addition, drought is becoming frequent and many people have been repeatedly exposed to hunger and famine. Hence, Government in partnership with Non-Government Organizations in Zimbabwe have been initiating and implementing drip irrigation project, with the objective of increasing agricultural productivity to improve the food security situation of the farming communities and to reduce dependency on the erratic rainfall (Adeoti, 2009). Drip irrigation improves yield, quality of crop and

income of farmers while using minimum water. However, there is still low uptake of drip irrigation by smallholder farmers and at the same time those that adopt drip irrigation will either use it for one season or drop out completely. However there is need to identify and investigate the determinants influencing the low uptake of drip irrigation by small holder farmers in Zimbabwe. The objectives of this study were: (1) to describe and explain the contexts of smallholder farmers' uptake of drip Irrigation in Zimbabwe, (2) to identify key determinants that influence the uptake of drip kits by smallholder farmers, (3) to identify complementary services such as extension and training and any other recommendations which can be made to increase uptake of drip irrigation.

Methodology

The study was limited to Mutare District of Manicaland Province in Zimbabwe. The bulk of the district falls in natural region IV which receives 300-400mm of rainfall per annum (Weather Forecast, 2016). The amount of rainfall received is mostly insufficient to cater for rain fed crop production, human and animal sustenance, and drought is likely to affect this area. Given the low rainfall in the area the study was set up to provide an opportunity to understand some factors influencing adoption of drip irrigation which adopted to enhance crop production.

In this study the target population were smallholder farmers engaging in crop production especially horticultural production in Mutare District. The smallholder farmers were drawn from farmers participating in the Agriculture Innovation Support Project (AISP) during the 2014/15 season. The database of farmers participating in the AISP project was obtained from the GIZ files. Stratified random sampling was used. This sampling method was used because the population is heterogeneous with groups of people who adopted drip irrigation and some farmers who did not adopt drip irrigation. Therefore using the same sampling fraction for all strata ensures proportionate representation in the sample. The strata were identified from the different wards in the district. The identified areas included Odzi, Chigodora, Marange, Shamhu and an area called thirty five miles. All drip kit adopters from Mutare district under AISP project were interviewed in the survey and the same number of randomly selected non drip kit users was interviewed too so as to give a fair representation of drip kit users and non-drip kit users in the sample.

In order to achieve the goals of the study, data was collected from sampled individuals from the study population by means of a survey questionnaire and interviews. A total of 46 farmers who adopted 120 drip kits in Mutare district under AISP were interviewed. Another sample of 46 non-drip irrigation adopting farmers were also interviewed in the study. Data was collected from all the 46 farmers who were involved in AISP III during the season 2014/15 with a total of 120 drip kits adopted. Farmers purchased as many drip kits as they wanted, GIZ did not limit farmers from getting more than 1 drip kit. However some farmers has more than 10 drip kits and each drip kit covers 250m².

Data analysis. The study made use of the Statistical Package for Social Scientists (SPSS v16). The Logit regression model and descriptive statistics were used to analyse the data

gathered from the smallholder farmers.

The Logit Regression Model

The proposed econometric model can be described by the following general form (Gujarati, 2011):

$$L_i = \ln (P_i/(1-P_i)) = \beta_1 + \beta_2 X_i + u_i$$

Where:

L_i = Linear regression model

P_i = probability of farmer adopting drip irrigation

$1-P_i$ = probability of not adopting drip irrigation

B_i (1, 2, 3,10) = regression coefficients

X_i (1, 2, 3,10) = independent variables and

U_i = error term.

The independent variables are variables specified as factors influencing uptake of drip irrigation and are defined below:

- X_1 = Educational level (Number of years of formal education)
- X_2 = Farming experience (age of farmer)
- X_3 = Agricultural income per year
- X_4 = Size of Farm
- X_5 = Access to information
- X_6 = Gender (male or female) in decision making
- X_7 = Labour (actual man count)

Results and Discussion

The main highlights that emerged from the survey are that smallholder farmers involved in drip irrigation mainly produce horticultural crops with most of the households producing crops for their own consumption as well as for selling. The main problems faced by farmers in using drip irrigation are clogging of emitters, hard labour in filling up the drip tanks and shortage of water. The drip irrigation adoption is influenced by the amount of labour available, age of the farmer, and access to information. Factors such as land size, household head's income, gender on decision making were found to have no effect on the adoption of drip irrigation technology (see Table 1).

Labor. In order to produce farmers need inputs. Labour is one of the production inputs used by farmers for production. The results show a positive relationship between labour in terms of man count and the drip irrigation adoption. As the smallholder farmer's labour increases by one man count the odds of adopting drip irrigation becomes 233 times more likely. This is due to the fact that the current drip irrigation technology being used by farmers requires a significant amount of labour as the farmers mainly use the manual pump and the bucket system to fill up tanks of the drip irrigation system. Results from the study showed that 28% of the farmers use the manual pump and 30% use the bucket system. These two methods are labour intensive. Hence, the higher the labour the higher the probability of adopting drips irrigation. A number of studies have used the household size as a proxy for labour whereby a positive relationship has been found between the household size representing labour and the adoption of an agricultural technology (Mignouna, 2011).

Table 1. Estimated parameters of the logistic regression model

	B	S.E.	Wald	df	Sig.	Exp(B)
Decisionmaker			2.141	2	0.343	
Decisionmaker1	1.735 ns	1.549	1.255	1	0.263	5.668
Decisionmaker 2	-0.441	1.248	0.125	1	0.724	0.643
Labour	5.451	1.612	11.430	1	***.001	233.076
Age	-0.156	0.064	5.982	1	** .014	1.168
Landsize	-0.048	0.128	0.139	1	0.709	0.953
Income per year	0.281	0.412	0.465	1	0.495	1.325
Source of info	-4.885	2.463	3.934	1	** .047	0.008
Years at school	0.66	0.225	0.543	1	0.461	1.180
Constant	-13.925	5.849	5.668	1	** .017	0.000

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

Farming experience. Age can be viewed as a proxy of the experience one has in farming as such farmers who are older are expected to be able to make better decisions based on their experience (Hofferth, 2003). The results from the study showed that as age increased by a year the odds of adopting drip irrigation by smallholder farmers are 1.2 times less likely. This finding confirms the findings by Etwire *et al.* (2013) who found a negative impact between adoption of a technology and age. This is because older farmers are risk averse and only want to adopt a technology when it has been proven to be effective.

Access to information. Source of information was significant to the study. The reference category was farmers who accessed most of their drip information from non-NGO institutions. The variable itself was entered as a dummy variable which showed that farmers who received drip irrigation information mainly from NGOs were 0.008 times less likely to adopt drip irrigation as compared to smallholder farmers who accessed most of their information mostly from non-NGO institutions such as the Agritex. The result shows that the source of information is important in order to encourage farmers to adopt certain technologies especially by institutions which deal with the farmers on a regular basis and have built a well trusted relationship. Access to information also reduces the uncertainties and risks associated with a technology (Caswell *et al.*, 2001)

Conclusion and Recommendations

The results from the study showed that labour and age had a positive impact on adoption of drip irrigation by smallholder farmers, while age had a negative impact on adoption of drip irrigation. On the other hand, farmers who accessed information from non-NGO institutions such as the Agritex and farmer groups were more likely to adopt drip irrigation than farmers who accessed most of their information from NGOs. The smallholder farmers used the drip irrigation kits to produce horticultural crops for their own consumption as well for selling. In terms of marketing the smallholder farmers mainly produce crops for sale at the local markets as well as selling from the farm gate. Few farmers marketed their produce to schools and external markets such as supermarkets. The study results revealed that the

majority of the farmers did not face challenges in using the drip irrigation kits. However, the smallholder farmers faced challenges in regarding water shortages, clogging of emitters, and hard labour as the farmers used the bucket system and manual pumps to fill up the drip tanks.

There is need to raise awareness on how farmers can take advantage of drip irrigation technology to improve both volumes of produce and quality. This would enable the farmers to capture markets such as schools, supermarkets and vegetable retailers rather than selling at farm gates as shown in the results that most farmers do sell their produce at farm gates. This can be done through information provision by producer groups and government departments such as Agritex on how to realise increased production and quality of produce through use of drip irrigation.

The government and developmental partners can help communities in setting up of dams/weirs to improve the supply of water throughout the whole year. Infrastructure would also entail providing loan schemes to farmers to purchase electronic pumps so as to reduce the burden of using manual pumps and filling drip tanks using the bucket system as this workload can deter farmers from adopting drip irrigation or continuing use of drip irrigation technology. Infrastructure building would also entail building centres for after service to reduce the incidences of clogging of emitters or pump breakdown. Construction of after service centres would also make it easier for farmers to purchase spare parts or new drip kits as replacement investment.

There is also a need to sensitize farmers about the benefits of drip irrigation giving them the necessary knowledge and skills especially the younger age below forty years as the results clearly shows that they are the one less to adopt drip irrigation. If farmers have the right knowledge they will adopt certain agricultural practices. It is also recommended that the extension workers should be equipped with more resources for information provision since the study found out that farmers who get information from non NGO organisations like Agritex are more likely to adopt drip irrigation. It is also recommended that drip kit suppliers should always have spare parts in stock so that farmers continue using drip irrigation.

The study that was conducted provided some empirical evidence on the factors affecting adoption of drip irrigation by smallholder farmers. Despite the contribution to the body of knowledge on adoption of irrigation technologies the reliability of the study results depend on the accuracy of the data obtained from the smallholder farmers. While this study focused only on adoption of drip irrigation by smallholder farmers in Mutare District there is room for further extension of the study. The study can be broadened to include the whole of Zimbabwe instead of one district. This would allow the sample size to widen capturing the diversity of the smallholder farmers in Zimbabwe.

The study made use of cross sectional data to find the factors affecting the adoption of drip irrigation by smallholder farmers. The use of cross sectional data is limiting as the study is carried out at one point in time. The cross sectional data can be combined with time series data so that farmers can be studied over time giving more reliable and accurate results. The issue of access to markets need to be examined. Drip irrigation kits require investment. The revenue

from selling produce from the drip plot of 250m² and the profitability made from that same drip irrigation affects the decision on adoption of a new technology.

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