

Full Length Research Paper

Agricultural input supply challenges of smallholder irrigation schemes in Zimbabwe

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This article focuses on irrigation agriculture as a critical adaptation strategy to climate change and population pressure in Africa. Smallholder irrigation schemes have been prioritised as a rural development model by many developing countries in the past five decades. However, the majority of the irrigation schemes have remained unsustainable and contributed very little towards the attainment of food security and poverty alleviation for the farmers. The study therefore unravels the underlying factors affecting the sustainability of smallholder irrigation schemes in Zimbabwe. A mixed research method, with a combination of the questionnaire survey, focus group discussion and key informant interviews.. The findings underscored farmers' productivity levels and input utilisation pattern as largely subsistence farmers who were unable to create sufficient demand to sustain a viable input supply chain. The study also demonstrates that fertilizers and hybrid seeds were not affordable for the majority of the farmers. The input supply market was not responsive to the spatial, temporal and package needs of farmers. The exclusion of farmers from the financial market allayed any hopes of breaking the underproduction cycles in the schemes. Thus, the study recommends that all the intervention in the input supply chain focus on transferring the purchasing power to poor farmers.

Key words: Input market, Market for the Poor (M4P), smallholder, irrigation scheme

INTRODUCTION

Irrigation agriculture enables human beings to be independent of the vagaries of natural rainfall and be able to grow crops in arid and semi-arid regions. Irrigation agriculture insulates the national agricultural economic sector against weather-related shocks and provides a more stable basis for economic growth and poverty reduction (Makurira et al., 2011; Nhundu and Mushunje, 2010). Globally, irrigated land constitutes 19% of the land under cultivation and supplies 40% of the world's food

requirements (Wiltshire et al., 2013). Irrigation is seen as a possible adaptation strategy for agriculture to climate change and population pressure especially in Africa where food security is highly fragile and easily disrupted (Wiltshire et al., 2013; Maliwichi et al., 2012). The need for agricultural intensification through irrigation is rapidly increasing as the population relying on farming has long surpassed the carrying capacity of many dry land agricultural systems in Africa (Kortenhorst et al., 2002).

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The population of sub-Saharan Africa, now close to six hundred million, is expected to double by the year 2020 and climate change has been identified as the major hindrance in meeting the food requirements for this ever-growing population (UNDP, 2012). Unfortunately, the majority of the smallholder irrigation schemes in Africa and Zimbabwe in particular have been associated with poor performance and have become unreliable and unsustainable beyond external assistance.

Smallholder irrigation schemes have been prioritised as a rural development model by many developing countries in the past five decades, not only because they have higher returns on investment but also because they are adaptable to the local farming systems (World Bank, 2008; Venot et al., 2013). Investment in irrigation agriculture, in the wake of climate change and chronic poverty in developing countries, is getting renewed attention from world and regional development bodies (WFP, 2010; UNCSD, 2012; UNDP, 2012 Leadership Council of the Sustainable Development Solutions, 2013; NEPAD, 2008). The recently agreed Sustainable Development Goal (SDGs) pledges to, by 2030, double the agricultural productivity and the incomes of small scale food producers through secure and equal access to productive resources, inputs, financial services and markets (United Nations, 2015). The SDGs were also set to ensure sustainable food production systems and resilient agricultural practices that increase productivity and strengthens capacity for adaptation to climate change, extreme weather and droughts (United Nations, 2015). However, the factors affecting the sustainability of irrigation schemes are not well understood (Manzungu and van der Zaag, 1996; Chancellor, 2004). Smallholder irrigation schemes are still pressed with a number of challenges which are preventing the country from reaching food autonomy and providing a route out of poverty for majority of the Zimbabwean rural population (Mudavanhu and Mandizvidza, 2013; Zimstats, 2015;).

Research on Zimbabwean small scale irrigation schemes has mainly focused on the analysis of the design options and water management (Chidenga, 2003), performance of small holder irrigation systems (Makombe and Sampath, 2010), financial viability and productivity of different crops under irrigation schemes, the identification of appropriate irrigation technologies and the socio-economic impacts of these schemes (Makadho, 2000; Makombe et al., 2004; Meinzen-Dick, 1993; Ruigu and Rukuni, 1990; Rukuni, 1984). However, little research has been conducted on the factors preventing the poor farmers from participating effectively in the different markets, especially the input supply market connected to the irrigation scheme (Zimbabwe Farmers' Union, 2002; Bindu and Chigusiwa, 2013) and how these were impacting on the resilience of smallholder irrigation schemes. As a result, the relationship between different markets connected to smallholder irrigation schemes (input, output, financial and land markets) has remained

poorly understood, especially what has been affecting the inclusive participation of the poor smallholder farmers in these markets. In addition, farmers in the schemes have always been part of the market as consumers, producers or buyers. These markets, for the farmers, have been instrumental in reducing poverty and sustaining agricultural production in other countries outside Africa (DFID, 2012). There is therefore, a growing interest amongst development agencies to identify and address the barriers currently preventing agricultural input supply markets from working for the poor farmers in Africa to sustain agricultural interventions (Ferrand et al., 2004; Garrette and Karnani, 2009; DFID, 2012; Magombeyi et al., 2012).

This study focuses mainly on the input supply chain because access to agricultural inputs, especially fertilizers and improved seed is a fundamental variable in increasing productivity level in irrigation agriculture. Anseeuw et al. (2012) argue that low agricultural productivity in Zimbabwe is related to a low level of capital input, leading to low uptake of productive farm technologies and, subsequently, to low yield and output. Anseeuw et al. (2012) recommend that the primary objective for Zimbabwe's agricultural reconstruction is to increase productivity levels. In the Green revolution that swept across Asia and South America, but unfortunately by-passed Sub Saharan Africa in the 1960s and 1970s, irrigation, fertilizers and hybrid seeds were primary ingredients (Ministry of Foreign Affairs of Denmark, 2013).

Agricultural markets in Sub-Saharan Africa are usually associated with market failures and inefficiencies with the poor smallholder farmers only gaining access to the markets at very high transaction costs (Poulton and Mukwereza, 1999; Makhura et al., 2001; UNDP, 2012). The input supply chain in Sub Saharan Africa is adversely affected by weak farmers' demand for more sustainable engineering practices (Tripp, 2003; Mwendera and Chilonda, 2013). Tripp (2003) and Veldwisch (2009) show how poorly developed agricultural markets limit the development and spread of technology in Sub Saharan Africa. Kenya exemplifies this as poor roads network reduce smallholder farmers' competitiveness due to high transport costs incurred in accessing markets for both agricultural products and farm inputs (Salami et al., 2010). Conversely, the traditional subsidised programmes used by the South African government as a mechanism to finance agricultural development in rural areas generally failed to yield the desired outcomes of getting farmers out of poverty (Belay et al., 2012; Musemwa and Mushunje, 2012; Cloete, 2013). Globally, the distribution of free inputs has been met with little success in sustaining smoothly functioning input supply systems (Albu and Schneider, 2008; Tschumi and Hagan, 2009; Heierli, 2013; Mutambara et al., 2015a). This is mainly attributed to the fact that NGOs and governments at times have no long-term roles within

a market (Ferrand et al, 2004). Free inputs have also been blamed for causing debilitating dependency amongst farmers (Chambers and Conway, 1992). The market for the poor approach hinted that market interventions be strategically resourced to avoid displacement of market mechanism. The approach advocates that transactional relationships be premised on trade exchanges and that ownership of interventions lie in the stakeholders with the wherewithal to continue performing the functions beyond the life of the interventions (Darkoh, 1998; Tschumi and Hagan, 2009; Mutambara et al., 2015a).

Resilience programming for smallholder farmers requires that program planners understand the operations of critical market systems and have an informed awareness of contextual issues surrounding agricultural interventions, farmers' choices, behaviour and decision making process (Ferrand et al., 2004). This study explores the challenges smallholder irrigation farmers face in accessing agricultural inputs (mainly fertilizers and hybrid seeds) and their effective usage, in order to enable development planners to design contextually relevant interventions. Thus, this study main objective is to evaluate the impact of the input supply market in the sustainability of the smallholder irrigation schemes. The following research questions are key to the study:

1. What are the smallholder irrigation farmers' problems in accessing the input supply markets?
2. To what extent are farmers accessing the output market?

The research is guided by the market for the poor approach (M4P) and the Sustainable Livelihood Framework approach (SLF). The M4P approach is "an approach to developing market systems so that they function more effectively and beneficially for poor people, building their capacities and offering them the opportunity to enhance their lives" (DFID and SDC, 2006, p. 1). The SLF's central argument is that; poor people, so often treated as residuals, should on the contrary be the starting point; and that putting the priorities of poor people first can achieve not only their objectives but also those of professionals and policy makers concerned with population, resources, environment and development (PRED) issues (Chambers, 1988; Serrat, 2010).

RESEARCH METHODOLOGY

An integrated research approach involving the use of quantitative and qualitative methods was used in this study. Questionnaire survey, key informant interviews, FGDs and observations were employed. This was necessitated by the fact that smallholder community irrigation schemes involve multiple stakeholders from multiple sectors and disciplines, whose 'multiple viewpoints, perspectives, positions, and standpoints' need to be considered (Johnson et al., 2007), to circumvent the risk of "doing violence to the complexity and diversity" of smallholder irrigation system (Soy,

2006). A commitment to inter-disciplinarity is often seen as a necessary precondition for successful resilience research, connecting people's time use patterns with their spatial and material footprints (Fahy and Rau, 2013).

Eight community small-scale irrigation schemes in the south-eastern Lowveld and the Midlands province of Zimbabwe (Tsvovani, Dendere, and Rupangwana in Chiredzi district, Zuvabuda and Vimbanayi in Chipinge district, Insukamini, Mutorahuku and Mambanjeni in Gweru district) were purposively selected for this study as shown in Figure 1. The South-eastern lowveld area lies within the agro-ecological region V which receives very little rainfall (less than 400mm per year) and very high atmospheric temperatures, making the need for irrigation technology more critical in the area than any other region in Zimbabwe. This study focused on smallholder irrigation schemes where farmers are in control of water, a critical variable in crop production. These farmers also have more interest in commercialising their operations since the water they pump requires expensive electricity which can be paid by making use of high yield enhancing technology. A random sampling method was used to select participating farmers through proportional sampling where a scheme with more farmers had relatively more respondents that were selected for the questionnaire interview. In order to determine who was to be interviewed, random samples were taken by assigning a number to each plot holder and using a random number table to generate the sample list. A total of three hundred and sixteen farmers were interviewed from the eight irrigation schemes. The multiple stakeholders involved in different value chains of smallholder irrigation schemes were also selected for interviewing for this study to assess how their levels of engagement were impacting on the sustainability of the schemes. These stakeholders included four Irrigation Management Committees (IMC), eight traditional leadership, relevant Government departments such as four Agritex officers, four Department of Irrigation officers, and four retail agro-dealers. Eighty one (forty three females and thirty eight males) farmers were interviewed through Focus Group Discussions across the eight irrigation schemes. Purposive sampling was used to determine the FGD participants. A farmer needed to be a member of the scheme in the ten years preceding the day of the survey to participate in the FGDs.

Data from the questionnaire survey was processed in SPSS and was subjected to both descriptive and advanced statistical analysis. Qualitative data from FGDs and key informant interviews were analysed using the thematic framework analysis approach.

RESEARCH FINDINGS: FARMERS' BARRIERS TO THE INPUT MARKET

Subsistence mind-set of the farmers

Eighty-five percent of the farmers interviewed indicated that their production in the scheme was for both household consumption and for sale. Fifteen percent of the farmers reported that their production was solely for sale with Dendere having the greatest proportion of farmers (eighty eight percent) who were producing solely for sale. The pattern suggests that most of the irrigation farmers were subsistence farming, defined as; "a system of farming intended to provide a self-sufficient lifestyle for the farmer and family where crops and livestock are maintained to support family need with little or no excess produced for marketing" (Business Dictionary, 2014: 1). The difference in the production objectives of the

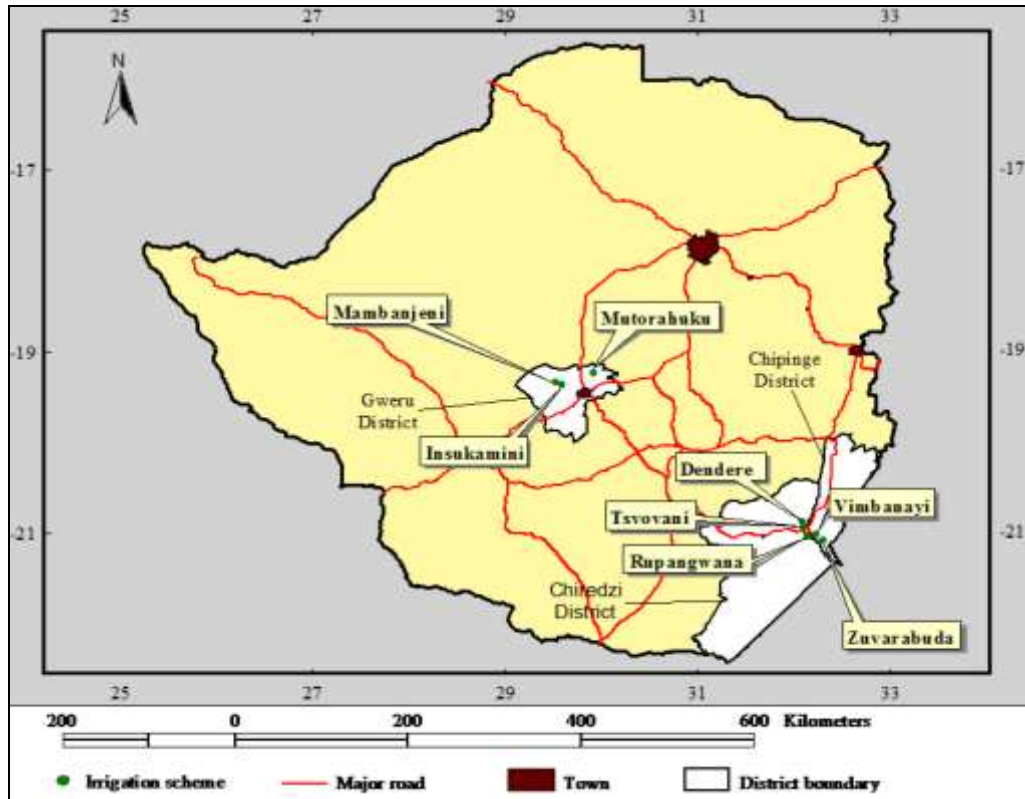


Figure 1. Location Map of the study area.

farmers across the eight schemes was shown to be statistically significant ($\chi^2=2.069$, $df=14$, $p<0.001$) while the differences amongst the farmers by gender and marital status proved to be not significant).

FGDs with the farmers indicate that even farmers who were growing tomatoes and other leafy vegetables wanted to satisfy their household grain requirements by barter trading the vegetable with grain. Most farmers were growing a variety of crops on their 0.1 hectares (average) not only to avert the possible negative effects of market glut resulting from specializing in one crop, but also to enhance their household food self-sustenance.

Underutilization of fertilizers

Eighteen percent of the farmers did not use top dressing fertilizer in their plots. Nineteen percent of the farmers used between 1 and 49 kg of top dressing fertilizer while twenty five percent between 50 and 99 kg and about nine percent used 200 kg or more kilograms of top dressing fertilizer. The difference by gender in the quantities of fertilizers used was not statistically significant by one way ANOVA ($F = 0.041$, $df = 1$ $p = .84$). The regression analysis between age and the quantity of fertilizers used in the previous cropping cycle highlight a negative relationship between these two variables. The older the

farmer, the less fertilizer he or she was likely to have used in the previous cropping cycle. This suggests that the elderly in the scheme were possibly faced with more financial challenges constraining them from accessing fertilizers than the relatively younger farmers especially considering that farmers considered fertilizer to be too expensive.

The age difference of the farmers on the quantities of fertilizers used (both Ammonium Nitrate (AN) and compound D (basal fertilizer) was also found to be statistically significant by One way ANOVA ($F = 2.286$, $df = 64$ $p = .000$). Farmers of different levels of educational background had used different quantities of fertilizers and the differences for both AN and compound D fertilizers was found to be statistically significant by One Way ANOVA ($F = 2.582$, $df = 64$ $p = .000$), with those who had not attained any level of education applying lesser fertilizer than those who had at least attained advanced level education. Farmers with different access to credit facilities had applied different quantities of fertilizer in the cropping cycle preceding the survey and the difference was found to be statistically significant ($\chi^2=1.436$, $df=15$, $p=0.000$). It was also shown that the availability of fertilizer in the local agro dealer shops influenced the quantities used by the farmers and the difference was found to be statistically significant ($F = 16.663$, $df = 15$ $p = 0.000$).

Agritex Officers in Zuvarabuda, Vimbanayi and Dendere indicated that they had trained farmers on the standard application of fertilizers recommended for each specific crop. However, only ten percent made use of the recommendations as fertilizer was considered to be very expensive by the farmers. Consequently, it was common for one to see pale coloured crops in the smallholder irrigation schemes showing signs of fertilizer deficiency. Agritex Officers blamed farmers' training programs for lacking the means of operationalizing the taught practices as there was no linkage between affordable inputs and the recommended doses of fertilizers, insecticide and hybrid seeding rates adhered to by farmers. The extension support was just a stand-alone activity that was not linked to the resources needed to put the acquired knowledge into practice.

Under-utilization of certified seeds

It was shown that forty five percent of the farmers in the eight irrigation schemes did not use certified hybrid seeds in the last cropping cycle preceding the study. Retained seed usually has lower yield potential than certified hybrid seed which when coupled with underutilization of fertilizer produces very low yields. For sugar beans, the majority of the farmers were using retained seeds. Farmers in Dendere scheme who used certified seed after the Agritex officer of the scheme arranged for group procurement of the seeds for farmers in the whole scheme. Differences in the number of farmers using retained seed by irrigation scheme was found to be significant at $P=0.05$. Vimbanayi had the highest proportion of farmers (sixty seven percent) that had used retained seed followed by Tsvovani (sixty two percent) while Dendere (thirteen percent) and Mutorahuku (twenty percent) had the lowest proportion of farmers that had used retained seeds. There was a weak positive correlation ($r = .043$, $df=1$ $p = 0.45$) between the quantities of maize harvested and the quantities of hybrid seeds used by the farmer.

The farmers that had not attained any level of education and those that had only attained primary level of education had the greatest proportion of respondents (fifty two percent and fifty three percent respectively) who had used retained seeds in the last cropping cycle preceding the survey. The difference by level of education on the quantity of AN and compound D fertilizers used was found to be significant at ($F = 2.776$, $df = 64$ $p < 0.001$), suggesting that more educated farmers were more likely to use certified hybrid seeds than less educated farmers. There was a significant difference ($F = 3.103$, $df = 13$ $p < 0.001$) on the quantity of fertilizer and hybrid seed used between farmers who felt inputs were available and those who felt inputs were not available in the local shops. FGD participants in Chiredzi and Chipinge confirmed that the use of retained maize seed

by the farmers was a result of the unavailability of the hybrid seed in the market. Agro dealers were stocking the seeds towards the rainy season to cater only for rain-fed farmers (who constituted their major client base) and not all year round.

Challenges in accessing inputs

Seventy-nine percent of the farmers had problems in accessing agricultural inputs. Fifty-seven percent cited lack of money as the major barrier followed by lack of credit facilities (forty-two percent) and high transport costs (twenty-six percent). The difference in the number of farmers facing problems in accessing inputs in the different schemes was found to be significant ($\chi^2=1.113$, $df=14$, $p=0.000$). Mutorahuku and Insukamini had relatively less farmers (fifty-nine percent and sixty-four percent respectively) compared to Dendere and Mambanjeni (hundred percent and ninety-seven percent respectively) who had problems in accessing inputs. Farmers were facing different problems in accessing input as shown in Figure 2.

Unaffordability of inputs

Fifty-seven percent of the farmers felt that inputs were not affordable for them and the difference amongst the schemes in terms of the affordability of inputs was not statistically significant ($\chi^2=1.376$, $df=1$, $p=0.241$). This suggests that farmers in the eight schemes generally felt the inputs were expensive regardless of their location. The difference by gender on the perceived unaffordability of the inputs was not statistically significant ($\chi^2=3.215$, $df = 2$, $p=0.200$) although women had a higher proportion of farmers (sixty-seven percent women against fifty-eight percent men) who felt the inputs were not affordable. The inputs were mainly accessed from town and the transport cost incurred made the inputs more expensive. Larger hectareage in Tsvovani irrigation scheme required more inputs (seeds and fertilizers) and tillage costs than the half hectare or smaller holdings owned by farmers in other schemes. The larger the hectareage the more difficult it was for the farmers to acquire the needed inputs.

Farmers in Tsvovani reported that 25kg of maize seed (costing sixty United States dollars) was needed to plant one hectare of land requiring four bags of compound D fertilizers (at a cost of forty United States dollars each) and at least 2 bags of AN (at a cost of forty United States dollars). The basic cost of inputs for one hectare was around three hundred and ten United States dollars which was not affordable for most farmers in the scheme. No credit facilities were available in the market to facilitate the procurement of high value inputs (such as fertilizers and hybrid seeds).

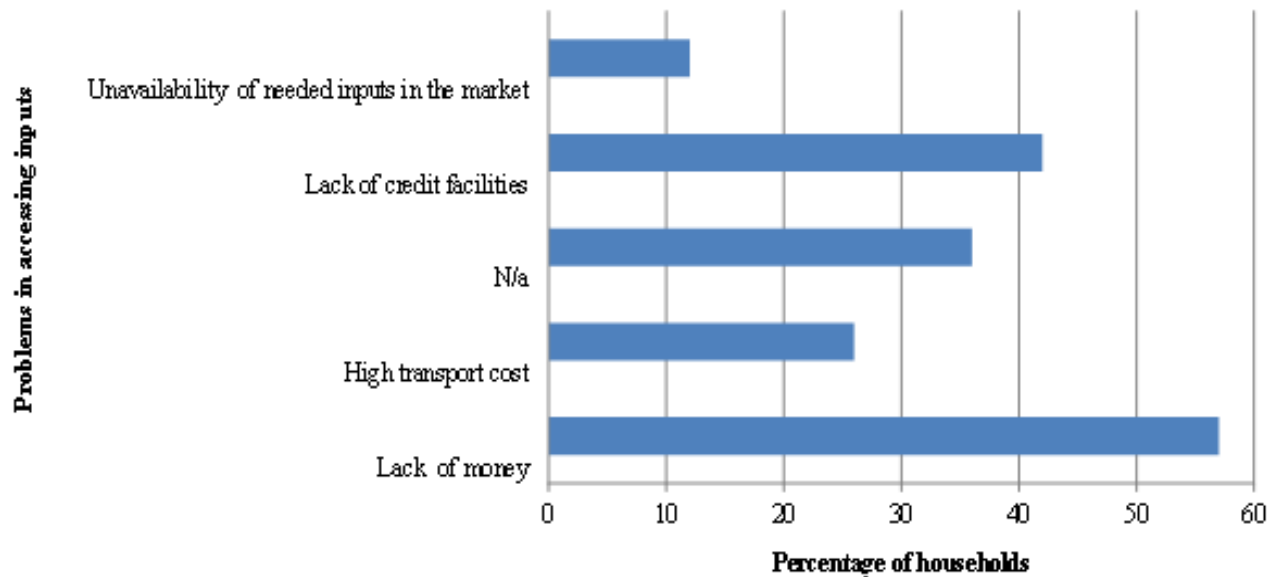


Figure 2. Farmers' problems in accessing agricultural inputs.

Lack of suitable agricultural inputs for irrigation schemes

Seventy two percent of the farmers reported that they could not get the needed hybrid varieties from the agro-dealer shops. Analysis found that the differences between the eight schemes on the availability of inputs in local agro dealer shops was significant ($\chi^2=1.113$, $df=4$, $p<0.001$). Tsvovani had the greatest proportion of farmers who felt the needed crop varieties were not available in the local shop. Another problem with the agro dealer shops in the South eastern low-veld was that they were supplying early maturing and drought tolerant but low yielding varieties like the Seed 401 and the Panner 413 which were not ideal under irrigation conditions. It was difficult for the farmers to get the five or six series varieties which had high yield potential under irrigation conditions. The argument presented by the local agro-dealers was that the demand for the seed varieties ideal for irrigation farmers was too low to sustain any meaningful business. Thus, the local agro - dealers primarily served the dry land farmers. A seed house company, Seed, also confirmed that it only supplied drought resistant varieties since the majority of farmers in the region bought what was on the market without verifying its suitability. The high yield potential varieties were usually supplied as per request, an arrangement which was very difficult considering that many farmers were buying their seeds on an individual basis requiring very small quantities (two to five kilograms). Irrigation farmers usually grow maize during the dry season for sell as green mealies (eaten as fresh cobs) but the seed was not usually available.

Incompatible inputs packages

The majority of the farmers were not getting the preferred or affordable package of fertilizers and seeds in the markets. Most of the seed varieties were sold in a variety of packages from 5 kg to 50 kgs in the areas serving the eight irrigation schemes. The difference of the seed packages available to farmers in the eight irrigation schemes was found to be significant ($\chi^2=1.059$, $df=4$, $p=0.001$) at $p=0.05$, with farmers in Dendere and Mambanjeni reporting that seeds in 5 kg packets were not available for them. Fifty-eight percent of the farmers preferred to buy their maize seed in 2 kg packages, twenty-eight percent in 5 kg, twelve percent in 10kgs while only two percent preferred buying in 25 kg packages as shown in Table 1. The farmers' seed package preference in the eight irrigation schemes were found to be significantly different ($\chi^2=40.34$, $df=42$, $p=0.001$) with over ninety percent of the farmers in Zuvabuda and Vimbanayi preferring 2 kg packages for seed while only thirteen percent of the farmers in Dendere and Rupangwana preferred 2 kgs. Variations in the preferences were related to the irrigation plot size with farmers with bigger plots demanding bigger packages.

Eighty-three percent reported that the local shops were selling fertilizer in 50 kg pockets while only ten percent and eight percent were buying them in 10 and 25 kgs respectively, as shown in Table 1. The difference by scheme on the packages the farmers were accessing was found to be significant ($\chi^2=14.41$, $df=14$, $p=0.000$). There was a complete mismatch between the fertilizer and seed packages that the farmers preferred with what

Table 1. Seed and fertilizer packages preferred/afforded versus packages available.

Seed packages available	Seed packages preferred/afforded (kg)					Fertilizer packages preferred/afforded	Fertilizer packages available (kg)		
	2	5	10	25	50		25	10	50
5 kg	33%	48%	18%	0%	0%	25 kg	15%	19%	66%
10 kg	81%	0%	19%	0%	0%	10 kg	0%	0%	100%
20 kg	55%	38%	0%	5%	2%	20 kg	0%	0%	100%
25 kg	50%	38%	11%	1%	0%	50 kg	0%	0%	100%
Total	58%	28%	12%	1%	0%	Total	8%	10%	83%

the market was offering, as illustrated in Table 1. The differences in the packages farmers afforded/preferred and the packages available in the retail shop was found to be significant ($\chi^2=75.019$, $df=12$, $p=0.000$).

The difference in what was available and what farmers preferred was preventing farmers from accessing the inputs although the respective inputs were available in the local market. One Agritex officer in Chipinge confirmed that smallholder farmers in irrigation schemes were not buying high yielding seeds varieties and the recommended quantities of fertilizers. One reason for the mis-match was that the input suppliers were not investing in research to understand the needs of poor rural farmers. Farmers preferred to buy in small packages (2 to 5 kg packages) although, small packages were effectively more expensive than bigger packages. Officials from Windmill and Zimbabwe Fertilizer companies and Pioneer and Seedco Company confirmed that they were not packaging in very small packages because it was more expensive for them than packaging in bigger packages.

Distant and weak input market

Fifty-four percent of the farmers were getting their fertilizers from different private dealers (including Farm and City 12%, Farm supply 1% unknown town shops, 21%, local agro dealer 15% while 5% got their fertilizer from the Zimbabwe Fertilizer Company (ZFC). This is attributed to the fact that most of the private distributors of the inputs were found in towns which were located eighty kilometres away from Zuvarabuda and Vimbanayi, sixty kilometres away for Tsvovani, Dendere and Rupangwana, between forty to fifty kilometres for Mutorahuku, Insukamini and Mambanjeni. Thus, the transport costs incurred to access these inputs made them more expensive. The local agro-dealers were weak and unreliable suppliers of the inputs needed in smallholder irrigation schemes. FGD participants, when asked about the local agro-dealers as sources of agricultural inputs had this to say; *“these ones don't stock seeds and fertilizers; they are for sweets and groceries”*. Those who had some agricultural input in their shops just had a few pockets of maize seed. Fifty-four percent of the

farmers obtained their fertilizer from private companies (12% from Farm and City Company, 1% from Farm supply, 21% from unknown shop in town, 15% from local agro dealers and 5% from ZFC). Twenty-eight percent of the farmers obtained free fertilizer, 21% of which was from Government and 7% from NGOs operating in their respective areas.

High tillage costs

Thirty-four percent of the farmers in smallholder irrigation farms did not own cattle and those who had cattle owned an average of two beasts. The FGD participants in Tsvovani where each farmer owned 3 hectares indicated that some of them were failing to fully utilize their irrigation plots owing to lack of draught power. Forty three percent of the farmers failed to fully utilize their irrigation plots in the last cropping cycle preceding the survey. The land utilization pattern of the 8 schemes was different ($\chi^2=30.51$, $df=32$, $p=0.001$) with Tsvovani having the highest proportion of farmers who did not fully utilize their plots. This was possibly because Tsvovani, unlike other schemes where farmers owned about 0.1ha, had 3 hectare plots for the farmers which required more capital to mobilize the required tillage service, seeds and fertilizer.

Focus Group Discussion participants across the 8 irrigation scheme and the researcher's experience with irrigation agriculture revealed that, unlike the rain-fed system, irrigation schemes required that land preparation be done over a short space of time to catch up with the irrigation cropping cycles. For the farmers that did not own their own draught power, it was very difficult to do the land preparation in time, especially those from Tsvovani. Lack of critical productive assets like ploughs, cultivators and harrows by the farmers ideally meant high production costs as farmers were forced to hire these at a high cost, further compromising the profitability of their farming activities. Farmers in Tsvovani confirmed that tractor hiring of tillage service was very expensive as it was seventy United States dollars (US\$70) per ha for ploughing and fifty United States dollars (US\$50) for discing or ridging. In Tsvovani, the three tractors that



Figure 3. Farmer using a hoe to prepare land for planting while tractors were packed in a shade at Tsvovani.

were left by the Agricultural rural Development Authority (ARDA) were all broken down with some reduced to pieces allegedly because farmers once attempted to build one tractor by cannibalising other tractors (Figure 3). This left farmers dependent on cattle draft power which was inadequate as forty percent of the farmers in the irrigation scheme had no cattle. Farmers owning small hectares in Mutorahuku, Dendere, Vimbanayi and Zuvarabuda prepared land manually using a hoe since they had no draught power and the plots were only 0.1 hectare in size. This is highlighted in Figure 3.

Negative effects of free inputs from the Government and NGOs

The government was distributing free inputs through the Grain Marketing Board (GMB) and it was clearly stated in the national media that the inputs were a free gift from the President of Zimbabwe, R.G Mugabe. The distribution was conducted soon after the 2013 national election in which the President and his party won the elections. According to the FGD participants in all the schemes, this was the second season they were obtaining free inputs since the adoption of multiple currencies. This is exemplified by one lady in Mutorahuku who had this to say:

Tinowanzowana mainputs emahara kana tave kuenda kumaelections kana kuti tichangobva mumaelections. Dei zvedu tichingoita maelections gore negore taibva taziva kuti zvedu zvaita.

(We always get free input when getting into elections. We wish we had elections every year).

The challenge highlighted during all the FGDs was that the inputs were distributed along political party lines and known opposition party supporters were denied the inputs. FGD participants also alleged that in Insukamini the free inputs from government were not fairly distributed and the quantities varied depending on one's

position in the party or one's influence in the community. Ten people were made to share 50 kg of AN, each getting 5 kg while others were getting 100 or 200 kg per person. Farmers also cited the untimely nature of the distribution as free inputs were distributed towards harvest or when crops were at tasselling stage. It was also highlighted that the government's free inputs distribution never targeted the irrigation farmers.

Non-Governmental Organisations (NGOs) were also distributing free input in Zuvarabuda, Tsvovani, Rupangwana, Vimbanayi, and Insukamini. The free inputs were mainly sugar beans, 1 bag of AN (Ammonium Nitrate) and 1 bag of compound D fertilizer. However, not all the farmers were given inputs as the program only targeted twenty-five percent of the scheme's membership because of limited supply of the inputs. According to the farmers in Dendere and Tsvovani, the Grain Marketing Board (GMB) Chiredzi depots used to supply agricultural inputs through a government credit facility targeting the irrigation schemes, but the support was neither adequate nor consistent. The agro-dealers in Chipinge and Chiredzi expressed that trading in agricultural inputs was not profitable. One agro dealer near Vimbanayi irrigation scheme had this to say; *"I will be mad to stock seeds and fertilizers here. I will be competing with NGOs and Government and I am usually a loser in the competition because their inputs are for free"*.

Seventy-four percent indicated that they had no access to loans from banks by the time of the survey and the difference by name of scheme was found to be statistically significant ($\chi^2=60.01$, $df=2$, $p<0.001$). Insukamini had fifty-eight percent of its farmers accessing loans while zero percent and only six percent accessed loans in Mambanjeni and Dendere respectively. Thirteen percent and eight percent had access to bank loans in Vimbanayi and Tsvovani respectively. The differences of schemes in the number of farmers who were accessing loans proved to be statistically significant ($\chi^2= 92.754$, $df= 14$, $p<0.001$). Differences by age, level of education, sex and marital status of the farmers on their access to loans

were not statistically significant ($\chi^2= 72.102$, $df= 11$, $p<0.001$). Discussion with farmers indicated that the majority of the farmers could not provide the needed collateral as the only assets they had (irrigation plots and cattle for some) were not accepted as collateral security by banks.

DISCUSSION OF RESEARCH FINDINGS

The majority of the farmers reported that they were producing for both household consumption and for commercial purposes. However, most of the farmers used over half of their harvest for household consumption. Sacks (2014), argues that if the degree of household consumption is as high as 50 percent, the farmers would be subsistence rather than commercial farmers. What further classifies most of the farmers as subsistence farmers was their growing of a variety of crops on their small plots to enhance their household food self-sustenance. Basing on Polish subsistence farmers, it was discovered that market-oriented farmers were less risk averse than subsistence-oriented farmers, as the former could be cushioned by markets, cash reserves earned from markets or credit lines from banks (Sacks, 2014).

The majority of the farmers found fertilizers to be unaffordable. This is in agreement with the FAO (2014) finding that even though one kilogram of nitrogen fertilizer produces 10 to 15 kg of grain but most African farmers cannot access or afford mineral fertilizer as it costs them two to four times the average world market price. FAO (2014) estimates the rate of fertilizer application for Sub-Saharan Africa to be 8 kg per hectare and the world average is at 93 kg per hectare while the Green Revolution countries of Asia use 100 to 200 kg/ha. The Abuja declaration on Fertilizer for an African Green Revolution recommends, considering that no region in the world has ever reached food security without increasing the use of fertilizers, an increase in fertilizer use for Sub-Saharan Africa to at least 50 kg/ha by 2015 (FAO, 2014; Ministry of Foreign Affairs of Denmark, 2013).

The unaffordability of agricultural inputs was exacerbated by the lack of credit facilities in both the input supply market and the financial markets need to facilitate the procurement of high value inputs (such as fertilizers and hybrid seeds). There was a statistically significant difference ($\chi^2= 52.211$, $df= 14$, $p<0.001$), between farmers enjoying different access to loans and the quantities of fertilizer used in the last cropping cycle preceding the survey. This confirms Kelly et al. (2006) finding that most farmers and traders feel that the farmers' demand for fertilizer would be low in the absence of credit facilities and subsidy policies to cushion farmers against very high prices for the commodity. The inaccessibility of credit facilities to acquire inputs for

irrigation farmers echoes Sheahan and Barrett's (2014) argument that the use of credit to purchase agricultural inputs in Sub-Saharan Africa is nearly non-existent. Mutambara, et al. (2015b) observe that the land tenure insecurity and lack of title deeds in Zimbabwe's smallholder irrigation schemes imply that the irrigation plots could not be used as collateral to borrow the much needed short and long term credit for investment in the irrigation schemes and to access hybrid seed, fertilizer and equipment. The centrality of the collateral requirement as a barrier to access loan is consistent with some research findings in Southeast Asia indicating low productivity level in smallholder irrigation schemes investment as symptoms whose initial cause is lack of access to relevant financial services. The underlying cause of the limited access to financial resources could be lack of formal title to landholdings acting as a major barrier to bank finance (Tschumi and Hagan, 2009). Hence a serial link between land tenure, access to credit and productivity.

Sheahan and Barrett (2014) demonstrate that in Africa, application rates for fertilizers were comparatively higher only in countries where Governments were subsidizing such as Malawi and Nigeria. Similarly, FAO (2005) notes that in Sub Saharan Africa the demand for fertilizer was heavily dependent on the availability of credit facilities and cash. Different countries in Sub Saharan Africa including Zimbabwe, Malawi, Zambia, Kenya and Tanzania invested in input subsidy schemes between the 1960s and the 1980s, in which farmers were given a wide range of agricultural inputs at controlled and subsidised prices or on soft loans (Ministry of Foreign Affairs of Denmark (2013). In Zimbabwe, the availability of subsidized credit drove smallholder fertilizer demand. This demand was sustained until the early 1990s when the price increase of fertilizer and other inputs, following the removal of subsidies after the Economic Structural Adjustment Program (ESAP), forced the smallholder farmers to reduce their fertilizer procurement (Zimbabwe Farmers' Union, 2002; Central Statistical Office, 2000). As was the case with other Sub Saharan countries, the subsidised input schemes were not sustainable as they were extremely expensive, inefficient, and prone to political manipulation, benefited the well-off farmers and remained dependent on continued external support (Sarfo, 2012). Literature also points to the unpredictability and non-linearity patterns of input packages available in Africa. For example, removal of agricultural input subsidies triggered a 40% decline in fertilizer use in Nigeria and Ghana, and 25 to 29% in Cameroon, Tanzania and Senegal (Sarfo, 2012). The same strategy caused an increase in fertilizer use of 5 to 500% in Benin, Togo, Madagascar and Mali (Sarfo, 2012). This trend suggests that 'one size does not fit all' and that the cost dimension, although important, is just one of the factors that affect farmers' access to fertilizer and hybrid seeds.

There was complete mis-match between the farmers'

preferred small input packages (2 to 5 kg packages) and the bigger input packages (25 to 50 kgs) available in the local shops as the fertilizer companies and seed houses were not responding to the needs of the irrigation farmers. Consequently, most farmers could not afford to buy the needed seed and fertilizers although they were available in the retail shop. In support, Kelly et al. (2006), using Senegal as a case study, note that certified seed was not bought by farmers not only because they were not associating it with higher yields, but because marketing locations, timing of sales and packaging could not meet the farmers' needs. The study underscored some of the challenges facing farmers in tilling their land as they have no draught power. This is corroborated by Moyo (2006) and Chawatama (2008) who observe in their respective writings that full utilisation of land amongst smallholder farmers in Zimbabwe is not only constrained by limited access to seeds and fertilizers but also by limited access to tillage machinery and equipment. Out of an estimate of 24 000 running tractors that were in Zimbabwe in 2000, less than 9000 tractors were operational in the country by 2013 (Moyo, 2006). Sheahan and Barrett (2014) echo this as they note that reliance on human power for tillage was still dominant in Sub-Saharan Africa and was greatly limiting productivity. Mrema (2011) also notes that Sub Saharan Africa has experienced a decrease in tractor use from 2 tractors per 1000 ha of arable land in 1980 to 1 tractor per 1000 hectare in 2011 while there is more than doubling of tractor prevalence in Latin America and Asia over the same period.

The Government of Zimbabwe and NGOs were active sources of free input for the farmers although the inputs were inadequate and the Government ones were unfairly distributed. The free inputs were also blamed for promoting a debilitating dependency amongst the farmers that permeated other linked markets. This has an agreement in DFID (2005) findings that the Government and donors or NGOs' direct intervention in the provision of agricultural inputs does not only generate intermittent and unsustainable supplies or fail to meet the needs of the poor but also that the supplies become a form of patronage. FAO (2005) and DFID (2012) discovered that Government free input schemes in Sub Saharan Africa have an adverse impact on private agro-dealers as they reduce the quantities purchased from the dealers. This also confirms Darkoh's (1998) finding that if market interventions are not appropriately resourced to help the poor, they can displace market mechanisms. Farmers were facing a number of barriers that were preventing them from participating in the financial market. The majority of the farmers (74%) had no access to bank loans.

CONCLUSION

The majority of the farmers were largely subsistence

farmers since agricultural inputs were very expensive. The free inputs distributed by NGOs and the Governments not only distorted the input supply market but also promoted a debilitating "free-riding" culture amongst the farmers. Farmers were not accessing loans from either agricultural input suppliers or financial institutions. Factors affecting farmers' access to agricultural inputs are interlinked. Each factor has an effect on the other factors. Lack of critical input leads to poor production, which does not only lock farmers in subsistence farming but also makes irrigation farming unattractive for prospective private sector investors and interventions through outright relief was also alienating genuine input market players. Lack of title deeds on the irrigation plots was preventing farmers from accessing the financial markets and inputs.

RECOMMENDATION

1. All the farmers in irrigation schemes need to be trained in farming as a business and market linkage to inculcate a business mentality in the operations and production systems in the irrigation schemes.
2. Policies with enforcement mechanisms should be put in place to ensure that aid in the form of hand-outs to farmers is discouraged to avoid debilitating dependency and to enhance farmers' level of ownership and responsibility in the irrigation schemes. Providing assistance through markets will also attract private sector players which will ensure sustainable engagement as both parties will be having mutual benefits in their relationship.
3. All the interventions aimed at improving farmers' access to agricultural inputs and alleviating poverty should strive to transfer purchasing power to the poor needy farmer. They should all be based on trade exchange transactions where both the poor farmers and the traders enjoy mutual benefits.

Conflict of Interests

The author has not declared any conflict of interests.

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