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Enhancing food security through micro-irrigation: Evaluating the contribution of treadle pumps to household food security in Umzingwane district of Zimbabwe

Tomson Dube, Mandlenkosi Maphosa *, Zenzo L. Dube, Gracious Ncube, Nevel Tshuma

Institute of Development Studies, Faculty of Commerce, National University of Science and Technology, P.O. Box AC 939, Ascot, Bulawayo, Zimbabwe

Abstract

Amongst a plethora of challenges facing the African continent today is the food security issue. Close to 240 million people in sub-Saharan Africa are food insecure (Bremner, 2012). A number of reasons have been advanced to explain the food insecurity situation of which inter-alia include climate change, low food and agricultural productivity and production. This article is centred on assessing the use of treadle pumps micro irrigation technologies strategy in an attempt to counter low food and agricultural productivity in Umzingwane district of Zimbabwe. Both qualitative and quantitative approaches were used with data being collected through questionnaires, focus group discussions and key informant interviews. A total of 100 smallholder farmers participated in the study which covered 6 Wards. Study findings reveal that the use of treadle pumps improves household food security though this inevitably comes at a cost to the natural environment. This is largely due to the way in which this form of micro-irrigation is practiced in the District. However, notwithstanding the positive contribution of treadle pumps to household food security, the use of these pumps is fraught with a number of challenges some of which include lack of backup services, spares, marketing and an unsupportive institutional environment.

Keywords: Food Security; Treadle Pumps; Micro-irrigation; Umzingwane; Entitlement

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* Corresponding author. E-mail address: phosaz@gmail.com, mandlenkosi.maphosa@nust.ac.zw

1. Introduction

Amongst a plethora of challenges facing the African continent today is the food security issue. Global estimates on the state of food insecurity paint a gloomy picture in sub-Saharan Africa. Close to 240 million people in this region are food insecure (Bremner, 2012). The prevalence of undernourishment, itself a key indicator of food insecurity, is very high in sub-Saharan African countries. Currently the prevalence levels are around 26.8% down from 32.8% during the period 1990-1992 (FAO, WFP, IFAD, 2012). These figures are significantly above the prevalence levels obtaining in the developed world for the same period which have been under 2% and are continually declining (FAO, WFP, IFAD, 2012). A number of reasons have been advanced in an effort to explain the food insecurity situation. Nkuepe (2012) amongst other factors, identifies conflict and political instability, unemployment and poverty, climate change, lack of cooperation and limited intra-African trade in food staples as the key triggers of food insecurity in Africa. The United Nations Economic Commission for Africa (UNECA, 2012) adds low food and agricultural productivity and production, land degradation, volatile food and fuel prices to the intricate set of factors that inform the food insecurity situation in Africa. These two contributions reveal the complex nature of the causal factors of food insecurity. As such for one to offer a more nuanced understanding of this phenomenon it suffices to narrow down to a specific dimension of the complex web of causal factors. To this end, this article is centred on one strategy that has been used in an attempt to counter low food and agricultural productivity and production in Umzingwane district of the Matabeleland South province of Zimbabwe. In this region and other semi-arid to arid regions of Zimbabwe, it has become evident that rain-fed agriculture is failing the smallholder farmer. Successive droughts, lack of inputs and erratic rainfall patterns have resulted in dwindling crop yields putting the food security status of the rural populace in a perilous position. As such, governments and development agencies have availed new technologies to counteract these challenges. One such technology is the treadle pump (sometimes called pedal pump) which has been adopted as a way of improving agricultural production and enhancing food security. Despite its potential role as a panacea to the food insecurity challenge, very little research has been done to ascertain the efficacy of treadle pumps in improving agricultural productivity levels and consequently enhancing food security in Zimbabwe. To counteract this caveat, this article evaluates the contribution of treadle pump technology to food security in Umzingwane district.

2. Food security: Concepts and measurements

The conceptualization of food security has been evolving over time and this has led to a multiplicity of interpretations of the concept. According to Maxwell and Smith (1992), there are more than 180 items that deal with definitional and conceptual issues relating to food security identified by Smith et al. (1992) in their bibliographic review. In the 1970s, food security was understood in terms of the supply dimension (UN, 1975). This meant that a country or any entity was seen as food secure if its food stocks matched or surpassed its food requirements. Thus a classic definition of food security in the early 1970s was “the ability to meet aggregate food needs in a consistent way” (Anderson and Cook, 1999, p.142). To satisfy this aspect of

the conceptualization of food security, this article assesses the contribution of micro irrigation technologies to improved farmer productivity and consequently to a certain extent, food security. This is done in cognizance of the input and output market environment.

In the 1980s, following Sen's (1981) seminal work on *Poverty and Famines* underpinned by the entitlements approach, food security as a conceptual goal expanded to include issues of access or entitlements. This dimension of food security was borne out of the realization that food insecurity was still visible even in countries where aggregate food supplies matched or surpassed aggregate food demand. According to Sen (1981) and other proponents of the entitlements framework, such an anomaly could be explained by 'entitlement failure' or 'food entitlement decline' as differentiated from 'food availability decline'. According to this framework, food can be acquired legally through four entitlements i.e. own-labour entitlement, trade-based entitlement, production based entitlement and inheritance and transfer based entitlement (Sen, 1981). In recognition of the fact that the issuance of treadle pumps to the smallholder farmers was an act of entitlement in the form of productive capital, this article examines how this entitlement directly or indirectly impacts the ability of the treadle pump supported households to acquire sufficient food on a sustainable basis. The major question in this regard is; does the use of treadle pumps ensure adequate household income to ascertain its security in terms of food access?

So far our conceptualization of food security has been premised on the availability and access of food. Food utilization forms the third pillar of the concept of food security. This is whether or not a household utilizes the best food that they have access to, if they choose nutritious food and if their body is healthy enough to absorb essential nutrients (Ignowski, 2012). Because of its highly technical and broad nature, this dimension is not the subject of this article except for some cursory appreciation of households' dietary diversity through analyzing the type of food consumed by the same.

An equally important dimension in the conceptualization of food security is stability. This is a dimension that emphasizes the stability of the three dimensions mentioned in the foregoing over time. Thus for food security to be guaranteed, a community or household should be in a position to withstand associated shocks such as economic, social, political and climatic volatility amongst others. Thus if a household or community fails to withstand shocks on particular periods then they are said to be experiencing transitory food insecurity, whereas if the food insecurity is over a long period and is informed by deep seated structural factors it is referred to as chronic food insecurity.

In consideration of the evolution of the concept of food security, current definitions usually encompass the three dimensions just described. A typical contemporary definition of food security is "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2011, p.5). This definition aptly captures this articles' conceptual framework which is adapted from the Food and Nutrition Technical Assistance (FANTA) project as shown in Figure 1.

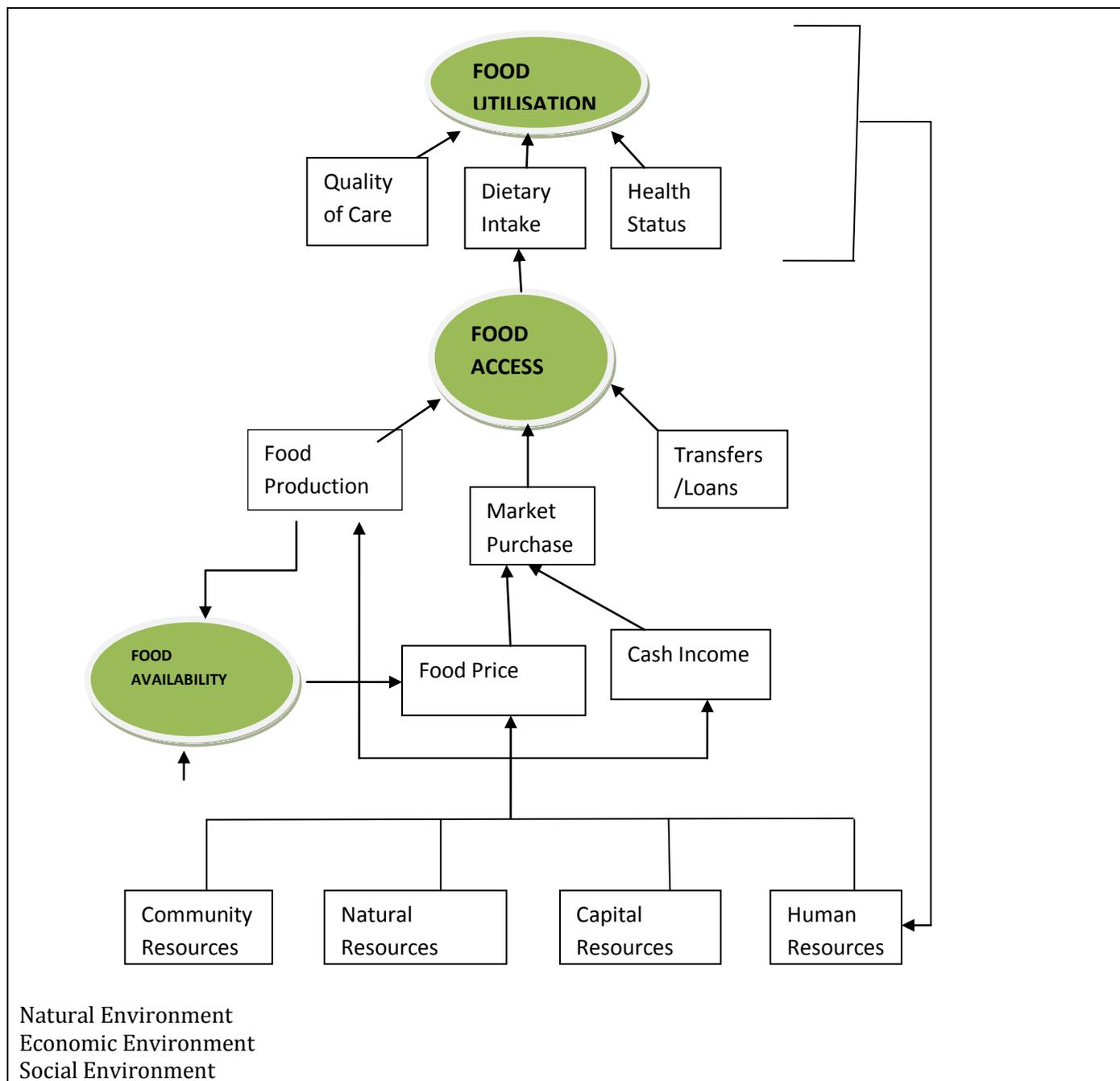


Figure 1. Food Security Conceptual Framework (adapted from Riely et al., 1999)

As a result of the complex nature of the concept of food security, its measurement has not been done in a universal way. Nonetheless, this article utilizes an adaptation of the Household Dietary Diversity Score (HDDS), Proportion of household food requirements met from own production and average number of meals consumed per day to measure household food security.

3. Micro irrigation technologies and agricultural productivity

Sub-Saharan Africa at large and Zimbabwe in particular, faces great challenges in dealing with high rates of poverty, food insecurity and malnutrition (AGWater-Solution, 2012). Agriculture is the most important sector in addressing the above mentioned challenges as it forms the backbone of most rural livelihoods. However, agriculture in sub-Saharan Africa is generally affected by erratic rainfalls (Adeoti et al., 2009). This has led to poor yields and low agricultural productivity in the region thereby failing to address the situation. To counteract the challenge of low productivity due to erratic rainfall irrigation technologies have been developed.

Modern Irrigation technologies worldwide have tended to increase agricultural productivity and improve livelihoods (Van Den Berg and Ruben, 2005; Hussain and Hanjra, 2004). Traditional irrigation technologies, though affordable in terms of capital requirements, their low delivery capacity and labour intensive make them unfavorable among the poor rural farmers (Kamara et al., 2004). The government of Zimbabwe, after the fast track land reform of year 2000, has sort to invest in the agricultural sector, through the Farm Mechanization scheme with attention being put on the development of smallholder irrigation. This was done with the intention of aligning communal farming with modern ways of agricultural production (SAFR, 1995). However, it has been argued by Adeoti et al. (2009) that modern irrigation equipment is a preserve for the wealthy and small holder farmers cannot afford to own and run them given the small pieces of land they are cultivating. The improvements in agricultural technology have seen the development of low cost ways of irrigation, which the rural poor can afford. Evolution in agricultural technology has seen the invention of low cost, affordable water lifting options good for micro irrigation (Schwab et al., 1993). According to the International Water Management Institute (2011) report, the introduction of treadle pumps micro irrigation technologies is one such option.

According to Kwamie (2011, p.1):

A treadle pump is a foot operated, single acting double cylinder pump for low lift irrigation. The pump's design consists of two metal cylinders with pistons that are operated by a natural walking motion on two treadles. The treadle pump can reach water that lies 7 meters below the surface more efficiently than a traditional hand pump. The pedaling action on the foot planks creates alternating strokes in the two pistons that lift the water in pulses.

The treadle pump is considered suitable and easily adaptable to African conditions (Adeoti et al., 2009). Kwamie (2011) argues that the treadle pump is an important irrigation innovation that increases efficiency for farmers. Kay and Brabben's (2000) Report notes that there is a general increase in crop intensity from once a season under traditional irrigation technologies to three times a year under treadle pumps. Shah (2000) argues that in South Asia treadle pump irrigators harvest remarkably higher yields than rain-fed farmers as a result of enhanced productivity. Kwamie (2011) posits that treadle pumps lead to higher yields and increase in crop variety, increase in economic livelihood and gender empowerment for female farmers as compared to traditional irrigation which are male oriented (Shah, 2000). Musara et al, (2010) share similar sentiments when they observed that smallholder irrigation schemes are financially viable if there is sound

management. Suryawashi (1995) observes that the use of treadle pumps in India has enabled smallholder irrigation farmers to participate in the main stream economy as they are involved in the production of cash crops such as paprika and sugar beans for both domestic consumption and international markets. Furthermore, Suryawashi (1995) posits that through micro irrigation income, the farmers in communal areas have improved on their infrastructure in the form of roads and telephone networks.

It can be argued that micro irrigation in developing countries has a great potential of addressing food security issues through enhanced agricultural productivity. To this end, this study sought to evaluate the contribution of treadle pumps to household food security in Umzingwane district.

4. Study area

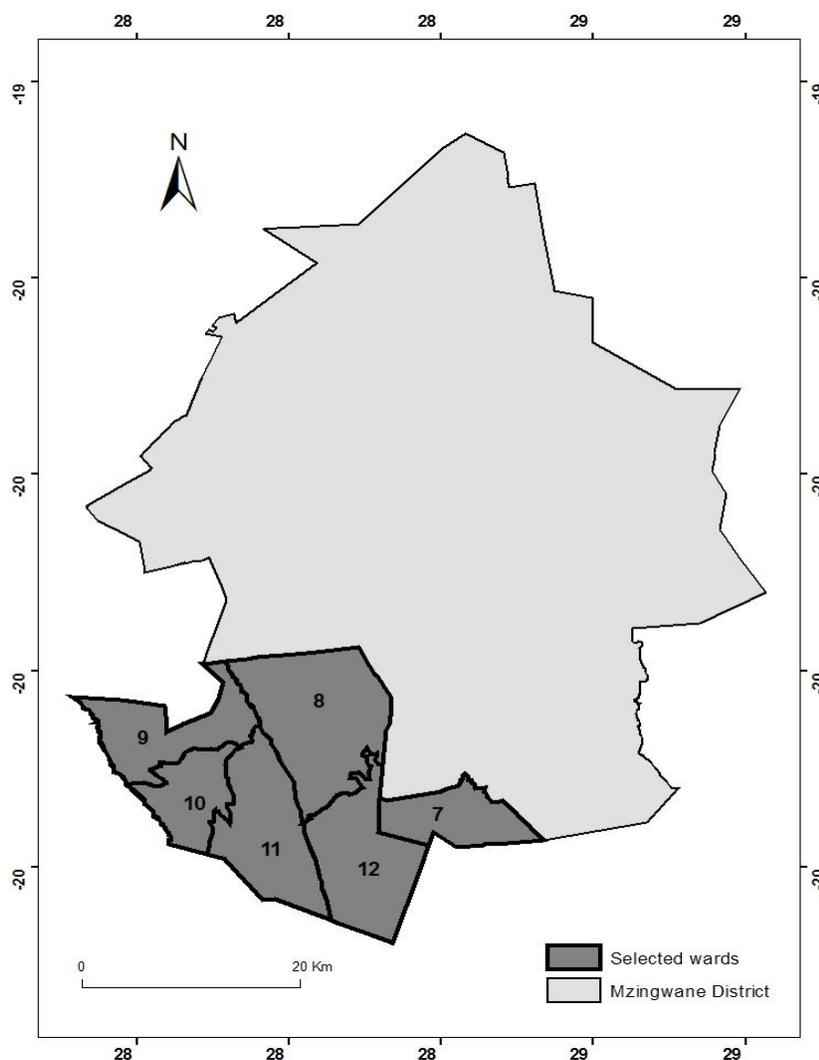


Figure 2. Umzingwane District Map Source: Sibanda, 2013

The study was conducted in Umzingwane District, Matabeleland South region of Zimbabwe. Umzingwane District has 20 wards which include Kirtons Farm, How Mine, Siphezeni communal land, Esigodini, Mzinyathini communal land, Mbalabala, Nswazi, Silobi, Matendale, Bushtick, Mbembesi and Matshetshe communal lands. Most villagers in Umzingwane rely on subsistence farming. The principal source of water is ground water. The District is in agro ecological Region IV which is characterized by rainfalls totaling 450-650mm per year¹. Umzingwane District is prone to recurring drought due to erratic rainfall patterns. There are no natural lakes but four rivers which dissect the District. Six large dams have been constructed with the largest one supplying drinking water to the nearby City of Bulawayo¹. As such the agro-ecological conditions and erratic rainfall can cause harvest failure such that most families rely on food handouts from the Non Governmental Organizations (NGOs). Poverty and unemployment levels are high. As a livelihood strategy, numerous small gardens exist that tap on the rivers through irrigation such as that of Treadle Pumps Technology (Jerie, 2010).

5. Methodology

The study was carried from early December 2012 to end of February 2013. In this research both qualitative and quantitative approaches were used. A total of 6 Wards were covered. These were wards 7 to 12 inclusive. The quantitative aspect of the study was in the form of a household survey. The survey used a questionnaire as a data collection instrument. The household survey used judgmental sampling as it was targeting only those households that had been allocated a treadle pump to use. These households were identified through the Department of Agricultural Technical and Extension services' workers who interact with the farmers on a regular basis. The questionnaire sought to demographically profile the respondents with a focus on their social and economic status. It also sought to establish the households' history of treadle pump usage and the impact thereof on food security within the households. For the purposes of this study, a household is defined as any group of individuals living together under the same roof or in the same homestead. A total of one hundred fully completed questionnaires were collected from these 6 wards. Data obtained through questionnaires were entered into the Statistical Package for Social Sciences (SPSS) version 16 and subsequently analyzed through the same by mainly deriving descriptive statistics such as frequencies.

The qualitative aspect of the study was exploratory and descriptive in nature as it sought to explore respondents' perceptions on the impact of treadle pumps on food security. Qualitative data was collected through focus group discussions (FGDs) and key informant interviews (KIIs). FGDs were carried out in three Wards, namely Ward 7 (Mathendele), Ward 9 (Zodula) and Ward 12 (Kumbudzi). The FGDs were semi-structured in nature and comprised of users and non users of treadle pumps. The key informants interviewed were namely: the District Administrator (DA), the District Agritex Extension Officers (DAEO) and Agritex Extension Officers (AEO). This was to gather expert opinion on the treadle pump usage in relation to household food security. The data was thematically analyzed.

¹ Environmental Impact Assessment - ACF Zimbabwe - June 2010 - Groupe URD (B. Renaudin & J. Patinet)

6. Results and discussion

6.1. Demographic and socio-economic profile of respondents

6.1.1. Sex and marital status of household heads

Out of the 100 respondents, 92 were male and 8 female. Umzingwane communities like most communities in Zimbabwe are patrilineal in nature which explains the high number of male headed households. The 8 female heads are all widowed with 4 men being of the same marital status whereas 82 other household heads are married, 4 are single and 2 are divorced. In terms of age, 80 respondents were 51 years of age and above. Table 1 below presents a summary of the ages of household heads:

Table 1. Ages of Household Heads

Age range in years	Frequency	Percent
31-40	2	2
41-50	18	18
51-60	46	46
61 ⁺	34	34
Total	100	100

Source: Fieldwork data

6.1.2. Household size

Fifty eight percent of the households are constituted by between 6-10 members. Table 2 below gives a summary of household size.

Table 2. Household sizes

Size of Household (Number of people)	Frequency	Percent
<=5	24	24
6-10	58	58
11 ⁺	18	18
Total	100	100

Source: Fieldwork data

The sizes of the households are moderate which explains why the mean size of household agricultural labour is around 4 people. Forty two percent of the households have at most 3 of their members who can provide some form of agricultural labour, whereas 44% have 4-6 of the same with 14% having 7 and above.

Research findings revealed that all respondents' livelihoods are agrarian based. Vegetable production is the mainstay with 58% of the respondents surviving through it, 34% through crop production and 8% eking a living through livestock production. Respondents' income levels are very modest with 66% of them surviving on an income of less than US\$100 per month. Twenty four percent earn between US\$101 to US\$200 per month. Six percent of the respondents have an income range of between US\$201 to US\$400 with the remainder (4%) earning above US\$400 a month. These average monthly incomes are reflective of the national picture in Zimbabwean rural areas which in 2011 stood at US\$58 (ZimVac, 2011).

In order to have an appreciation of respondents' sources of income and to gauge the importance of vegetable production in their livelihoods, respondents were probed on whether they derived their income from a provided range of livelihoods options. Figure 3 below presents as summary of respondents' sources of income.

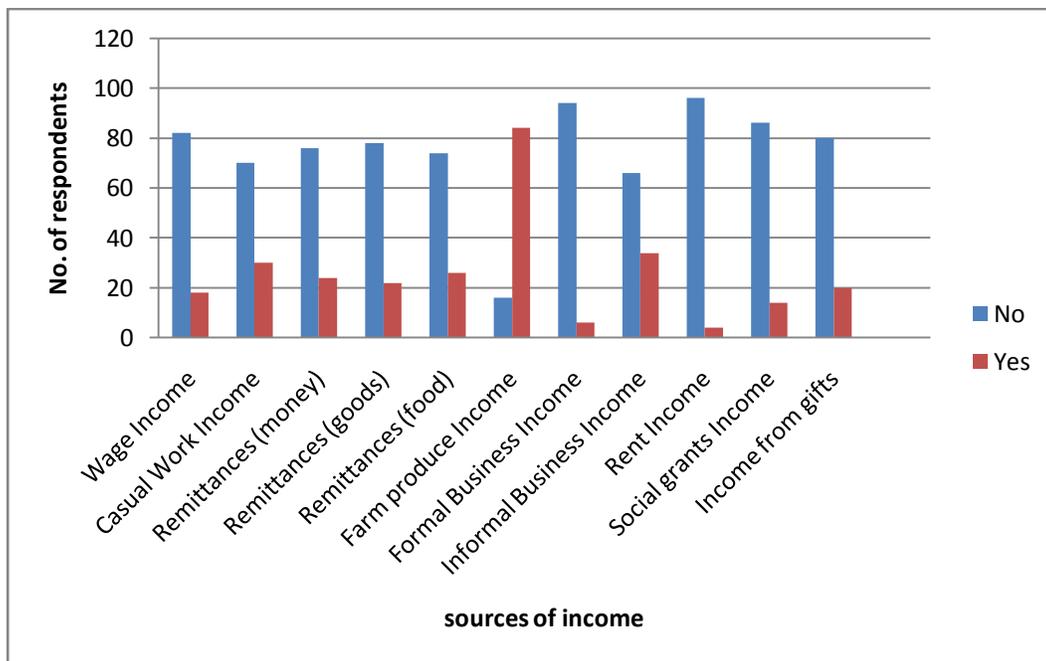


Figure 3. Households' major sources of Income (Source: Fieldwork data)

It is evident from Figure 3 that vegetable farming is the most important source of income amongst the treadle pump users as 84% of the respondents indicated that they derive income from growing vegetables. This is typical of the situation in the rest of the Province as in 2011 vegetable and food crop production sales accounted for a significant portion of household income (ZimVAC, 2011). Other key issues relating to income are that employment levels are low amongst the sampled households probably due to a depressed labour

market that has prevailed during the period of economic crisis in the country. The general coping strategy has been to operate informal business which could account for the 34% of respondents who indicated that informal businesses are a major contributor to their households' incomes. As for remittances in their different forms, levels of inflows are not significant enough which is atypical of the Matabeleland South Province. This could be a result of deliberate misinformation by the respondents in an attempt to ensure that they project a picture of vulnerability to ensure they are not denied access to food assistance extended by mainly NGOs.

6.2. Treadle pumps usage

All the respondents attributed their ownership of a treadle pump to NGOs, specifically the Organisation of Rural Associations for Progress (ORAP) and Help Age Zimbabwe. One of the respondents had also gone further to buy an additional one from his savings. Of the 100 respondents, 96% still own the treadle pumps whereas 78 of them are still using their treadle pumps. Seventy four treadle pumps users use them individually, whereas 4 use them as a collective. In terms of period of usage, 70% of the respondents have been using treadle pumps for between 5 to 8 years. Study findings reveal that some kind of training on treadle pump usage has been offered to the recipients of treadle pumps. Eighty two percent of the respondents indicated that they had been trained in the usage of treadle pumps whilst 18% had not received any form of training. The Government and NGOs have been the major institutions responsible for the training of treadle pump users. Of those who attended training, 98% adjudged the training to be effective. However, notwithstanding the effectiveness of the training, a significant number of respondents (42%) had not received any refresher training from any quarter since the initial training. An equally problematic issue is that there has not been any backup service to support the treadle pump users. As such, 58% of the respondents indicated that they maintained their pumps whereas 40% said there is no maintenance or back up service from any quarter. Only two respondents claimed to have been assisted by an NGO in the maintenance and repair of their treadle pump. This lack of backup service is affecting the operations of the respondents as 74% of them said they are facing challenges in accessing and procuring spares. For example, during the FGDs some of the issues raised by respondents were that pedals were too brittle and the spares for belts were not easily found hence they had to improvise. They further stated that they were willing to spend their own money on spares and additional treadle pumps if made available.

Eighty four percent of the respondents indicated that they had received some kind of agricultural support with most of the support coming from the Department of Agricultural Technical and Extension services (Agritex) in the form of extension services. Seven percent of the respondents received agricultural support in the form of contract growing arrangements.

As stated in the foregoing, although the Umzingwane district is generally dry area it has about four rivers that run through it. This could explain the fact that 52% of treadle pump users rely on rivers as their source of water whereas 42% and 6% rely on wells and dams respectively. This overreliance on natural water systems is an antithesis to the principle of irrigation farming as it means farmers are still largely prone to the vagaries of weather, in this case erratic rainfall. Thus most of the water sources used by farmers are

ephemeral, implying that even with treadle pumps, farmers at times fail to reap the maximum benefits of owning a treadle pump. Another issue raised by community members in an FGD in Kumbudzi Ward 12 is that the use of treadle pumps has at times resulted in conflicts between livestock farmers and treadle pumps owners. The discussants said because of the use of natural water bodies by treadle pump farmers there sometimes is conflict with livestock farmers who see treadle pump supported farming activities as a threat to the availability of water for their livestock. An equally worrying issue is that of environmental sustainability given that most farmers are cultivating along stream banks. The lengths of the donated watering pipes were cited as another challenge as they were too short (30m) to water cultivated areas located far from water sources. The farmers pointed out that the ideal length would be over 100m. Soils close to water bodies are not always arable. This is likely, to lead to land degradation and river siltation in the long run. Such a development would be affront to the very concept of food security which in its rudimentary sense implies secure access to food in the present and future.

In terms of usage, all the respondents use treadle pumps for vegetable gardening. However, there are some other uses which are summarized in Figure 4 below.

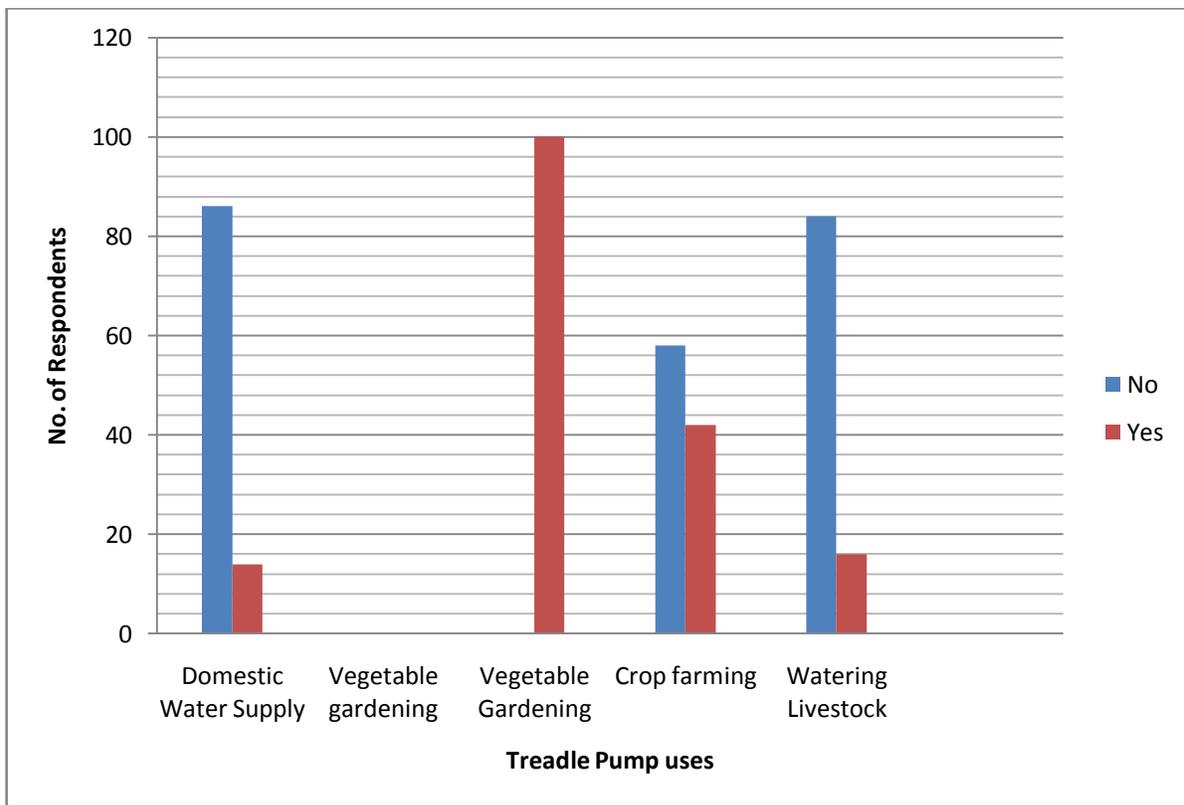


Figure 4. Treadle Uses (Source: Fieldwork data)

6.3. Treadle pumps, agricultural productivity and food security

The use of treadle pumps has resulted in a green belt within the District. Treadle pump users grow a variety of green vegetables such as cabbages, beans, carrots, various kinds of leafy vegetables, squash, peas, butternuts, tomatoes, onions, chilies and potatoes. Other than vegetables, respondents also indicated that they also use treadle pumps for growing crops as indicated in Figure 3 in the foregoing. Crops grown include mainly maize, sweet potatoes and groundnuts. In an FGD in Kumbudzi in Ward 12 one of the participants who is a non-user of treadle pumps said those with treadle pumps could afford to grow a wide variety of crops as treadle pumps are efficient in watering. She said “...with a bucket if I do [water] once, the one with a treadle pump can do 20. As such they have better yields to the extent that we end up borrowing from them”. These sentiments were echoed in other wards where all the FGD participants noted that the use of treadle pumps improved the availability of food as it remarkably increased yields.

The wide array of food crops grown in the District could be used as a proxy indicator of a good Household Dietary Diversity Score (HDDI). To determine the extent of households’ dietary diversity, respondents were asked to indicate the average frequency of specified nutritional intake on a weekly basis over a 90 day period. A summary of the findings on the same is presented in Figure 5.

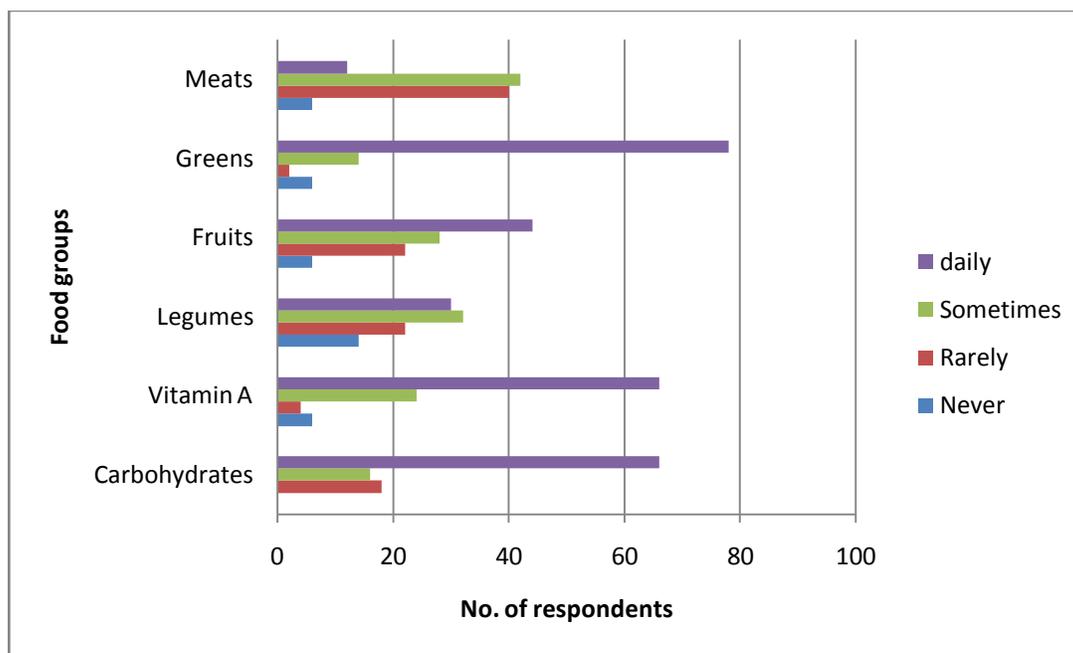


Figure 5. Frequency of Households’ Intake of Specified Food Groups (Source: Fieldwork data)

The impact of treadle pump usage is evident in the high intake of greens amongst the respondents where 78% of them indicated that they eat some form of leafy vegetables on a daily basis. Households’ nutritional intake of other important food groups is also impressive and compares favourably to the averages obtaining

in other districts in the country (cf ZimVAC, 2013). The important role played by treadle pumps in the respondents' food security status is further buttressed by the fact that this study was carried during the peak hunger period which is generally between December and February just before the next harvest. This can be explained by the fact that some of the treadle pumps users with access to reliable water supply can even grow crops in winter (which is the dry season) which makes food available all year round. An FGD participant in the Dianna's Pool area said "in the past we had problems of food because of drought spells but now treadle pumps make food available because we grow crops all year round and sell some of the produce to buy some of the foodstuffs we cannot produce".

Another determinant of food security used in the study was the average number of meals taken on a daily basis in the last seven days preceding the study. Sixty two percent of the respondents indicated that they have three meals in a day. This is against an average of 28% in the rest of the Matabeleland South Province (Zim VAC, 2013). Twenty eight percent have on average of two meals in a day whereas 2% have one meal against Provincial averages of 57% and 14% respectively (Zim VAC, 2013). The remaining 8% have more than 3 meals a day.

To further gauge respondents' perceptions on the impact of treadle pumps on their food security status, respondents were asked to proportionally evaluate the amount of their household food requirements met from own production on a scale of 1 to 10 before and after the use of treadle pumps. As shown in Figure 6 below, 78% of households indicated that they met more than 50% of their household food requirements from own production. This is in contrast to 26% of households who could achieve the same before the use of treadle pumps in the District.

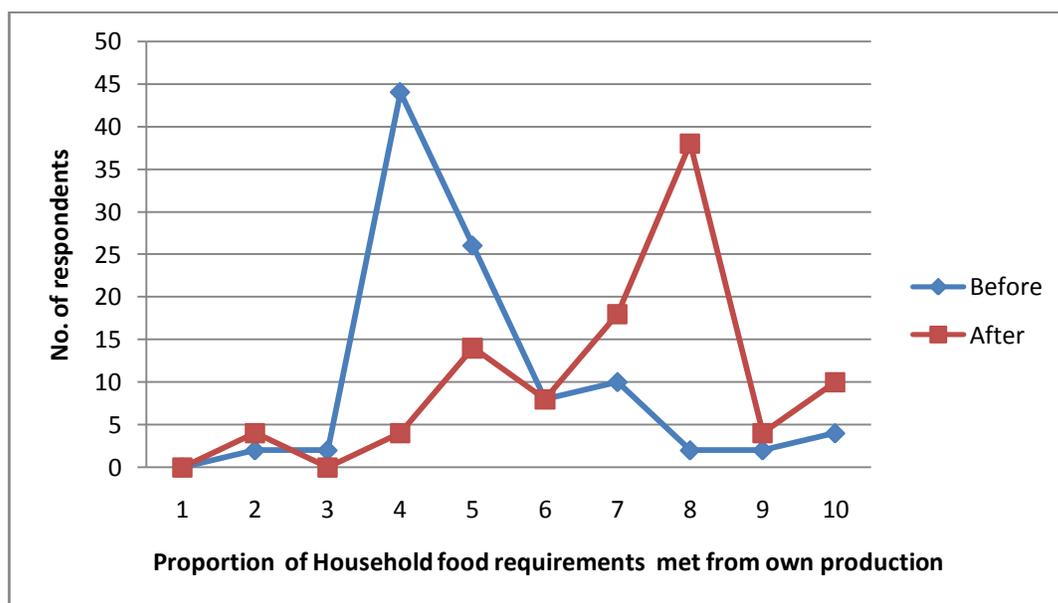


Figure 6. Proportion of Household Food self provisioning before and after the use of treadle pumps (Source: Fieldwork data)

The positive correlation between treadle pump usage and proportion of household food self provision through own production could be partly explained by a corresponding increase of acreage under food crop cultivation by most treadle pump farmers.

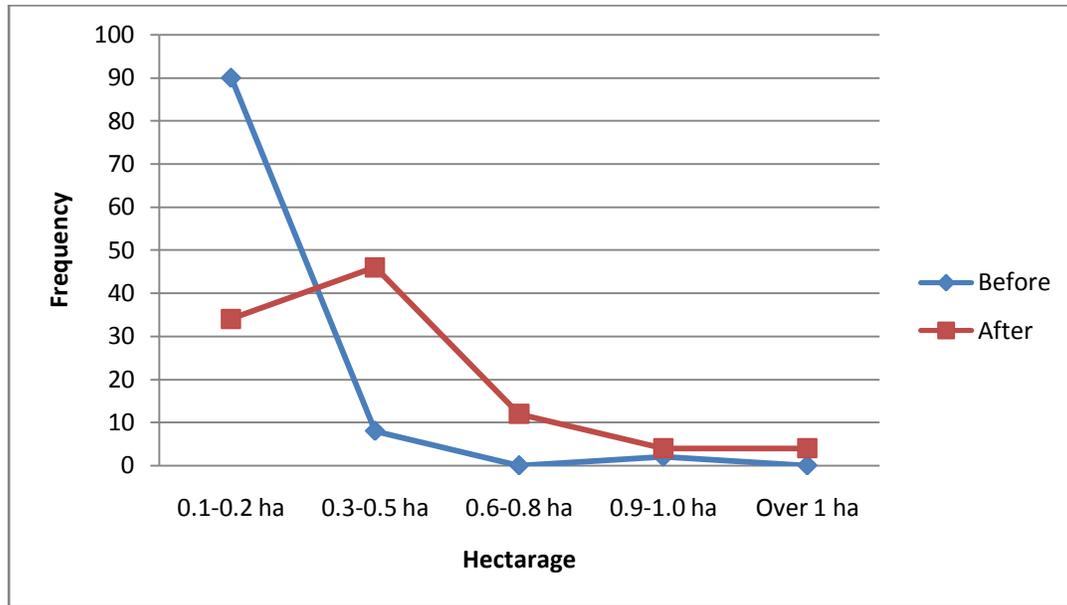


Figure 7. Hectareage Under Food Cultivation before and after treadle pump use (Source: Fieldwork data)

Before the use of treadle pumps 90% of households cultivated between 0.1 to 0.2 hacteres whereas after the use that figure declined by 56%. After the adoption of treadle pumps 66% of the respondents indicated that they were now putting over 0.3 hacteres of land under food crop cultivation. This is in contrast to 10% before the respondents started using treadle pumps. Notwithstanding this positive correlation between treadle pump use and hectrage under food crop cultivation, farmers’ efforts to increase hectrage are hamstrung by a low labour base whose mean size per household is 4. Other factors militating against the achievement of full potential in terms of hectrage under cultivation are market related.

All respondents indicated that they sell some of the treadle pump supported farm produce. However, of those farmers, 6% indicated that they had no access to markets. Significantly, 56% of those who market their produce have problems in accessing markets. Fifty four percent of the households indicated that they sell their produce on the local market, whereas 6% and 40% sell to the District and out of District markets respectively. The sale of produce is hamstrung by low demand as indicated by 46% of the respondents. This low demand could explain why 76% of the respondents identified low prices as a major challenge in their operations. The low demand coupled with market glut for vegetables produced by treadle pump farmers lead to low prices especially within the communities as the communities are too small to absorb all the produce. Whilst this is seen as a negative impact on the part of treadle pump users, it could have positive spin offs for non users in the District as they are in a position to access food items at low prices.

Treadle pump users indicated that with better institutional support, they can realise much more meaningful returns from their gardening activities. This was in reference to poor transport infrastructure and unreliable transport services which denied them the opportunity to penetrate out of the district markets which have a potential for higher returns. Those who sell their produce in Bulawayo cited harassment, arrests, extortion, volatile market prices as some of the major challenges they faced in trying to sell their produce in the City. Poorly developed markets and market linkages could deter the treadle pump farmers from expanding their operations as they end up incurring losses. Thus, this environment militates against respondents' attempt to expand their sources of entitlement. Given the necessary support, the farmers have a potential to generate income, acquire more assets and create employment. These preceding factors could create a strong buffer against food security shocks.

7. Conclusions and recommendations

The study has shown that treadle pumps are an effective strategy to counteract transitory food insecurity more than chronic food insecurity. Short term fluctuations in food production levels and prices can be addressed through the use of treadle pumps as the pumps enable households to grow more at shorter intervals than they would under rain fed agriculture. However, some of the food insecurity obtaining in the District stems from deep seated structural factors which can only be addressed through macroeconomic initiatives. More so, the environmental sustainability of treadle pump supported agricultural activities is in question as the Technology promotes stream bank cultivation which is likely to lead to land degradation and river siltation.

The benefits of using treadle pumps are further compromised by an unfavourable climatic environment. As a result of low and erratic rainfalls, households end up failing to realize maximum benefits from this initiative as in some instances water sources dry up. In addition, the markets which are operational in the District are not well developed denying the farmers maximum returns for their produce. It would help if the local authorities and NGOs operating in the District developed market linkages for the farmers.

In as much as this study's focus is on food security, it does not claim to have addressed all the dimensions of food security as it relates to treadle pump usage. For instance, a more nuanced study on intra-household dynamics is necessary to give a much clearer picture on the impact of treadle pumps on household food security since aggregate household food security does not imply security for all household members.

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