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Small grains "resistance"? Making sense of Zimbabwean smallholder farmers' cropping choices and patterns within a climate change context

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Abstract: This paper aims to understand why smallholder farmers in Zimbabwe are "resisting" to adopt small grains as a strategy for adapting to the negative effects of climate change. The uptake of small grains has been very low among smallholder farmers in climate change affected districts in Zimbabwe in spite of expert advice. The paper seeks to interrogate this "refusal" by smallholder farmers to adapt through small grains. Data were collected using fifty (50) in-depth semi-structured interviews and five (5) key informant interviews in Tsholotsho, Zimbabwe to understand why smallholder farmers are not shifting to small grains production en masse in response to climate change to address food insecurity gaps. The paper finds that there are a plethora of reasons leading to the non-adoption of small grains as a climate change adaptation strategy. The explanations vary. The paper thematically provided a critical overview and analysis of the attitude of smallholder farmers on small grains cultivation. The literature systematically selected, provided a wide coverage of the small grains production value chain. The narratives of farmers through interviews reveal their lived experiences and attitudes on small grains. This paper provides a new understanding of why small grains programming has not been successful in Zimbabwe over the years. The paper recommends that

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Dr Keith Phiri is a Lecturer in the Department of Development Studies at Lupane State University. He has research interests in livelihoods and the environment, particularly in the area of climate change. He has researched on smallholder farmers' adaptive responses to global warming. Keith also has research interests on gender issues, poverty, globalisation, democracy, sustainable livelihoods and food security. Keith also has a keen interest in monitoring and evaluation. He holds a PhD in Social Sciences (University of Fort hare, South Africa) where his study focus was on the efficacy of small grains and small livestock production as technical climate change adaptation options in

Tsholotsho and Matobo, Zimbabwe. He has a number of research articles from referred journals on climate change impacts and adaptation. This particular research paper is a continuation of the thematic issues the researcher pursues on climate change.

PUBLIC INTEREST STATEMENT

The purpose of the paper is to understand why smallholder farmers are reluctant to produce small grains (sorghum and millet) in the context of climate change. Small grains also known as drought-resistant crops are adaptable to the negative effects of climate change compared to maize. However, the study shows that farmers continue to produce maize despite the known scientific advantages of small grains in the face climate change. Using secondary sources such as journals and reports, and also views from interviewed farmers as primary sources, the study reveals the reasons for the rejection (resistance) to growing sorghum and millet. Findings relate to labor constraints, quelea birds, limited government support, and consumer preferences and marketing challenges among other inhibiting factors. The paper recommends that the government takes practical steps to enhance the uptake of small grains production through assisting farmers by training and funding projects of such nature for resilience building.

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Subjects: Development Studies, Environment, Social Work, Urban Studies; Social Sciences; Sociology & Social Policy; Environmental Sociology

Keywords: Climate change; sorghum; millet; semi- arid regions; Zimbabwe

1. Introduction

Climate change is one of the biggest threats facing humankind today and is already having adverse impacts in Zimbabwe, particularly in rural areas where the majority of the population (67%) lives and mostly depend on agriculture-based livelihoods (Apraku, Moyo, & Akpan, 2018a & Apraku, Akpan, & Moyo, 2018b; IPCC, 2014; Dube & Phiri, 2013; ZIMSTAT, 2013; Adger, Huq, Brown, Conway, & Hulme, 2003). There are increasing calls for the production of small grains, such as sorghum, millet, and rapoko instead of maize production in order to enhance food security against the background of climate change in Zimbabwe (Gukurume, 2010). The Food and Agriculture Organization (FAO) & International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (2008) argue that sorghum and millet have the potential to contribute towards food security in many of the world's poorest and most food insecure agro-ecological zones like Zimbabwe. It has been argued that sorghum and millet have the potential to improve household food security in semi-arid regions because of their adaptability to such environments (Taylor, 2003).

2. The case for small grains

The rationale for a shift from maize production to small grain production is premised on a number of scientific reasons. Firstly, sorghum and millet are believed to be more ecologically compatible with semi–arid areas compared to maize because of their drought tolerance (Dube, Mlilo, Moyo, Ncube, & Phiri, 2018; FAO, 2008). It is on the basis of their strong adaptive advantage to climate change and lower risk of failure in comparison to maize that they are advocated for. Secondly, Mukarumbwa and Mushunje (2010) postulate that small grains require little input during growth and with increasing world populations and decreasing water supplies, they will be important crops for future human use. Thirdly, Chazovachii, Chigwenya, and Mushuku (2012) highlight that finger millet grows in a wide range of climatic conditions. It has a long storage life and is seldom attacked by insects and molds. Small grains' long storage life makes them important as a risk avoidance strategy in food security (Chazovachii et al., 2012). Small grains also serve other functions besides addressing the key issue of food insecurity. Gukurume (2013) asserts that they can be used for non-alcoholic beverages and for beer brewing in traditional ceremonies. However, despite these positive attributes of small grains within the context of climate change, their uptake is very low among smallholder farmers in climate change affected districts such as Tsholotsho and Gwanda in Zimbabwe (Dube et al., 2018). This paper explores why smallholder farmers are resisting scientific advice to adopt small grains like sorghum and millet.

3. Methodology

This study is based on a review of literature and field research which was conducted through data gathering utilizing fifty (50) in-depth interviews from farmers in Tsholotsho and five (5) key informants from Agricultural Technical and Extension Services (AGRITEX) and Environmental Management Agency (EMA). Two wards in Tsholotsho, namely, Dlamini and Phumula were purposively selected. The investigation targeted a variety of sources on small grains. Literature review complemented the fieldwork research. Firstly, a google scholar search was made for literature on small grains in Zimbabwe using a variety of keyword combinations including "'small grains'", "'Zimbabwe'", "'climate change'", "'food insecurity'", "'semi-arid regions'", "'sorghum'" and "'millet'". Several papers were harvested on line using this method. A preliminary check on the papers was made to establish relevance to the study. Once this phase was completed, the papers were individually read and thematically analyzed for factors hindering the adoption of small grains

in Zimbabwe. Other grey literature was systematically accessed by visiting relevant government departments, local and international non-governmental organizations websites (including the Food and Agriculture Organization).

4. Grain production trends in Zimbabwe

The study found out that contrary to efforts to promote small grains, small grain production in Zimbabwe has actually been progressively declining over the past 14 years (Chanza, 2018; Gukurume, 2013; Nhemachena, Mano, Mudombi, & Muwanigwa, 2014; Taylor, 2003). The decrease experienced has been both in area and production. The Crop and Livestock Assessment report for the 2012/2013 season indicated very low national average productivity levels of sorghum (0.32t/ha), pearl millet (0.3t/ha), finger millet (0.24t/ha), against the expected level of 2 to 4t/ha. Finger millet has been decreasing sharply every year as most farmers are no longer willing to grow the crop. Improving productivity of small grains is the key to food and nutrition security in the context of climate change and variability (Matthew, 2015; Ndlovu, Mpofu, & Moyo, 2019; Nhemachena et al., 2014). As already indicated climate change and variability has led to increased frequency of drought and extended dry spells in both marginal and high potential areas (Dube & Phiri, 2013; Kebede & Nicholls, 2012; Songok, Kipkorir, Mugalavai, Kwonyike, & Ngweno, 2011). The decline in the production of small grains may be attributed to the low incentives being given to farmers who produce it. These incentives out-compete the small grains on farming land available. The government has also been funding to produce high yielding maize varieties and also providing free maize seed to smallholder farmers.

Sorghum and millet are important cereals for the maintenance of food security in Africa (Food and Agriculture Organization (FAO) & International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), 2008; Muchuru & Nhamo, 2019; Taylor, 2003). Taylor (2003) notes that this is because of their high levels of adaptation to African conditions that small grains constitute half the total of cereal production on the continent and as such could be a major source of protein for the population if cultivated. However, despite these arguments, households in Zimbabwe continue to prefer the production of maize.

5. Smallholder farmer's perceptions and attitudes towards small grains

5.1. Labor constraints of cultivating small grains

Smallholder farmers in Zimbabwe face labor-related challenges in sorghum and millet production which lead them to prefer maize production. These challenges include the heavy burden of cultivating sorghum and millet in comparison to maize. Alumira and Rusike (2005) and Matthew (2015) reveal that rising labor costs in small grain production have affected most farm operations, from land preparation, weeding, bird scaring to harvesting and grain processing. In addition, the ease with which maize can be processed compared to the traditional staples of sorghum and millet is the other reason why maize became widely accepted in Zimbabwe's semi-arid regions during the green revolution (Alumira & Rusike, 2005; Matthew, 2015). An elderly research participant echoed that:

Conservation farming (Gatshompo) is unsuitable for the elderly farmers. Digging holes and removing weeds at least three times is not what they are used to. Although in my opinion, the yields are higher than on conventionally tilled land- the intense labour involved is simple a deterrent. They cannot cope especially in the face of a scorching sun. (Household respondent 7, Phumula ward)

Alumira and Rusike (2005) further assert that even under semi-arid conditions, it might be very difficult for small grains to compete with maize. This is because sorghum and millet do not yield much crop residue, which plays a very important role in smallholder farmers in terms of animal feed and crop manure. Similar observations were noted by Wilhite, Hays, and Knutson (2005) that livestock depends upon crop residues for survival during the winter, mainly from maize stalks. Small grains do not offer fodder for cattle, unlike maize which feeds both the farmers and their livestock. Consequently, smallholder farmers continually have an inclination towards maize production.

According to (Chanza, 2018; Rukuni & Eicher, 1994; Scoones, 1998) higher labor costs in both cultivation and processing and poor technology, are another reason for the non-adoption of small grains. They further argue that lack of improved varieties and credit, weeds, pests, and diseases limits the adoption of small grains as a strategy for climate change adaptation. Maunder and Tembo (2006) argue that in Tanzania, poor cultural practices, lack of improved varieties, diseases and pests, limited uses, unpredictable markets, and limited research hamper the adoption of small grains. Carney and Ashley (1999) listed lack of good varieties, weeds, lodging, disease, and moisture stress in dry areas as the contributory factors for a lack of interest in small grain production. In Kenya, the challenges to small grain production were low research priority, limited uses, and difficulty in management, lack of improved varieties, poor crop husbandry, competition from other crops with better economic returns, and lack of commercial food products (Chambers & Conway, 1992).

5.2. Quelea birds

Small grains production is unattractive to smallholder farmers because the crops are much prone to consumption by quelea birds. Taylor (2003) argues that small grains face a major challenge of depredations of the quelea birds on sorghum and millet than does on maize. Many people are reluctant to grow millet and rapoko in fear of huge flocks of voracious +red-billed quelea birds that have the potential to wipe out crops resulting in low yields (Dhliwayo, 2007). The red-billed quelea bird is a major pest of small grain crops in Zimbabwe both on irrigated wheat and barley in the winter and on sorghum and millet in the summer. The red-billed quelea birds have been a continuing challenge on small grain crops in Zimbabwe. One of the respondents from the household interviews remarked that:

> *Our sorghum and millet are labour intensive because of the quelea birds. From the month of March to May we have to guide our fields from 6am to 6pm daily. We use whips, mud stones and also burn moist leaves to drive them away. All other domestic chores are suspended during that period. If you fail to guide the field, the crops will be completely destroyed. The quelea birds are really a menace. (Household respondent 2, Dlamini ward)*

The intensity of the challenges of these birds is concentrated in low- and middle-veldt areas in both the north and the south of the country. While for the period January to April, these birds feed on the ample wild grass seeds and insects, they sometimes have an impact on rain-fed crops in particular, sorghum, millet, and rapoko. Locals know these birds very well and use various scaring methods against them. However, these methods do not deter birds from flocking onto the crops. Over the years, the problem of these birds on small grain crops has been reduced by apparently changing to maize, a crop which these birds do not eat. Moreover, smallholder farmers prefer maize productions which are prone to attacks by baboons and wild pigs which are easier to chase away. Therefore, a major reason for the non-adoption of small grains by farmers is the constant monitoring of the fields due to the quela birds which is a deterrent for the production of small grains (Dhliwayo, 2007; Matthew, 2015).

5.3. Quantity of yields produced

According to (Sukume, Makudze, Mabeza-Chimedza, & Zitsanza, 2000; Brazier, 2015) the production of maize continues to dominate in Zimbabwe's semi-arid regions compared to small grains as it offers higher yields. They further note that low yields of small grains have acted as a major obstacle and challenge for smallholder farmers in Zimbabwe's semi-arid regions to expand and adopt production of small grains on a large scale compared to maize. This lower productivity causes small grains to be very unattractive to communal farmers in the semi-arid regions (Food and Agriculture Organization (FAO), 1995). Therefore, small grains face a major challenge of low yields per hectare compared to maize hence most farmers prefer to grow maize regardless of the region in which they are in. A household interview participant remarked that:

> *I would rather concentrate on planting maize rather than pearl millet. It is more profitable than pearl millet. However, our climatic conditions do not favor maize cropping. Maize suffers from moisture stress compared to pearl millet. Pearl millet is like our president Robert Mugabe. It survives all adversity. I am forced to cultivate pearl millet over maize due to what you call climate change.* (Household interviews respondent 1, Dlamini ward)

According to sorghum is the third most important cereal crop in Zimbabwe and the principal food for many Zimbabweans, predominantly those living in semi-arid rural regions (cited in Winniefridah & Manuku, 2013). Furthermore, Chisvo (2001) argues that in Gokwe area, millet has become unpopular with the new generation which does not appreciate the advantages of traditional seed crops in resisting diseases and pests attack (cited in Winniefridah & Manuku, 2013). Tsiko (2007) also concurs and points out that this causes reduced exploitation of traditional food which may have a better nutritional value than commercial foods. There is also a social stigma associated with the consumption of traditional foods (Tsiko, 2007). These are viewed as "poverty crops" making people to turn to them during floods and droughts. New agricultural practices and urbanization have also reduced the availability of indigenous foods in Zimbabwe and Africa. This is compounded by the fact that the production processes of small grain crops are cumbersome; from weeding, harvesting, to post-harvesting processes like threshing, winnowing, and post process.

5.4. Lack of government support

Rukuni and Eicher (1994) argue that lack of government support in Zimbabwe for production, processing, and use of crops that are tolerant to drought has resulted in people in the drier areas changing their tastes from small grains to maize. Mudimu (2003) asserts that there is no clear policy promoting small grain crop production amongst smallholder farmers in Zimbabwe's semi-arid areas where they are said to have a comparative advantage over maize. As a result, the production of small grains has been on the decline in Zimbabwe due to policies that favor the production of maize which is considered a cash crop.

The government has been offering subsidized inputs in the form of mainly maize seeds and fertilizer to resettled farmers and communal farmers. Nonetheless, Foti, Muringai, and Mavunganidze (2007) observed that not much benefit has been achieved from the government-subsidized input scheme, especially in the semi-arid regions because input packages and the variety that are being issued do not tally with the agro-ecological location of the farmer. These views are further supported by the Food and Agriculture Organization (FAO) (1995) and Food and Agriculture Organization (FAO) (2015b) reports which argues that the Zimbabwe government support measures for small grains have been shown to be relatively minimal compared to maize, and the latter has encroached into sorghum and millet land. This is despite studies that have shown that small grains have a comparative advantage in these semi-arid regions over maize (Alumira & Rusike, 2005; Muchineripi, 2014; Muchuru & Nhamo, 2019; Mukarumbwa & Mushunje, 2010). Commentators have pointed to the lack of government's support on small grains farming as the obstacle to the growth of small grains farming. An optimal agricultural policy by the government would be one that provides small grains inputs to farmers on arid lands and maize to those on good rainfall regions. One participant from the household interview echoed that:

> *In our ward, seeds and fertilizer is only given to farmers who practice conservation agriculture (Gatshompo). I understand they were registered and joined a particular group of farmers but I do not know how because that information was not passed on everyone. So, should we suffer because we don't do conservation agriculture? Government should support all of us regardless of what farming technique we use*. (Household respondent 5, Phumula ward)

To support the above citation, an EMA official remarked that:

> *Availability of small grains seed is still a problem as you will realise that most seed retailers have more of maize seed varieties compared to sorghum and pearl millet and thus it goes to show that their supply is unstable*. (Key informant, EMA)

Generally, there is a strong incentive for the production of maize rather than small grains which is prompted partly by government policy and agricultural extension services that target maize production, aggressive marketing by seed houses and millers, favorable pricing policies and good demand (Muchuru & Nhamo, 2019; Taylor, 2003). High-yielding maize varieties and technology are also readily available in comparison to small grains where there is little attention in terms of breeding and genetic improvement of sorghum and millet crop varieties. Alumira and Rusike (2005) suggest that if government policies are crafted in Zimbabwe that support the production of sorghum and millet at the same level as maize, then an increased production in these crops can be achieved in semi-arid areas.

Similar findings by Rukuni, Tawonezvi, Eicher, Munyuki-Hungwe, and Matondi (2006) show that lack of government support in Zimbabwe for production, processing and use of crops that are tolerant to drought has resulted in people in the drier areas changing their tastes from millet and sorghum to maize. FAO (1995) argued that for sorghum and millet to compete with maize in the limited resources of the communal farmers, there is a need for them to outperform maize in terms of yields. This entails massive investment by government and the private sector in the development of hybrid sorghum and millet varieties that have higher yields and better taste than maize (FAO, 1995).

5.5. Lack of knowledge

Farming of small grains like finger millet requires knowledge especially during weeding time as it tends to have weeds that look exactly like the plant (Gukurume, 2013). To the unpracticed eye, it is difficult to distinguish, and this may result in pulling out the finger millet leaving out the weed. Therefore, there is a need for more education among the rural households especially the young generation (Amnesty International, 2004). Furthermore, due to lack of knowledge, most farmers do not allocate more inputs to small grains compared to maize. Some grow small grains in their worst part of cropping land and others do not prioritize time of planting and fertilizer management (Dube, 2008). This has a negative effect on their production. Many assume that once the crop is planted, it grows up to harvesting without weed control. Currently, few farmers use fertilizers on small grains (AGRITEX Tsholotsho, 2017; Mallet & Plessis, 2001). A young farmer from the study area echoed that:

> *If I had my way like most of my peers, I would plant and cultivate maize. Sorghum and millet are cumbersome and an arduous task for me. We are producing sorghum and millet in keeping with the tradition of the elders and of its suitability in our village. The elders in our village assist us with the knowledge of producing the drought resistant crops. Otherwise, as the young generation our knowledge is limited.* (Household respondent 10, Phumula ward)

In addition, AGRITEX Tsholotsho (2017); FAO (2008) supports the notion that inputs need to suit farmer agro-ecological region for better returns to be realized if Zimbabwe is to address its food insecurity situation through increased agricultural production. Inputs of sorghum and millet should be distributed to low rainfall areas while inputs of maize should be distributed to high rainfall areas. Rohrcach and Kiriwaggulu (2007) is of the view that there has been not much diversification from maize as the dominant source of food in Zimbabwe. Even in drier areas where small grains can be produced economically and sustainably, maize is the mainstay of household food security.

5.6. Consumer preferences

A number of households do not like eating meals prepared using *rapoko* but prefer eating *isitshwala* (Zimbabwe's traditional staple food) from maize meal. Further, it is noted that not many people, particularly in the urban areas, like to eat flour from these crops except on prescription from medical doctors. This is because of their color, taste and flavor and the general practices and lifestyles in some families. If consumers are reluctant to eat the products of millet, there is no incentive to produce for them. Instead, the crop is mainly produced and used for preparing traditional beer brands like *Chibuku* (Zishiri, undated).

FAO (1995) and Mengistu, Shimelis, Laing, & Lule (2018) also link production constraints toward sorghum and millet to changing food preferences. The report highlights that as income rise, consumers tend to purchase wheat, rice, and maize rather than traditional coarse grains. As a result, smallholder farmers tend to view sorghum and millet production as having lower returns than other enterprises. Real producer prices for sorghum, millet, and edible legumes dropped considerably, since the trade liberalization program of the 1990s, compared to that of cash crops and maize (Macgarry, 1994). This has also acted as a major reason why rural farmers have shunned small grain production in favor of maize.

The decline in per capita consumption has been influenced by changes in consumer habits, rate of urbanization, time and energy required to prepare food based on sorghum, condition of marketing facilities, processing techniques, stability of supplies and relative availability of sorghum products (Macgarry, 1994; Taremwa, Gashumba, Butera, & Ranganathan, 2016). These changes in consumption habits have been largely concentrated in urban areas (Food and Agriculture Organization (FAO), 1995). In addition, national policies in some countries have had a negative influence on sorghum utilization as food. For instance, large imports of cheap wheat and rice policies to subsidize the production of these crops in developing countries have had a considerable negative impact on the production of sorghum (FAO/WFP, 2000; Mengistu et al., 2018). Smallholder farmers generally prefer dual-purpose crops that can be used for household consumption and also marketable whenever there is a surplus. Maize serves as a dual-purpose crop while small grains are not. To substantiate the argument raised above, one respondent remarked that:

> *Sorghum and pearl millet meal are generally disliked by people who come from urban areas. They think it is dirty because of its dark brownish color. Maize meal is white. In addition, sorghum and pearl millet meal consumption is associated with being very poor and also linked to suffering from terminal illnesses. This stereotype is predominant especially by some individuals who are not resident to our area*. (Household respondent 3, Dlamini ward)

5.7. Lack of diverse processing technology

Sukume et al. (2000) have explained the lack of processing technologies as yet another factor that has hindered the development of alternative formal markets for sorghum and millet. By using traditional processing technologies, sorghum takes longer to process than maize especially during harvesting. This factor has reduced its demand even amongst the poorest of the poor communal households (AGRITEX Tsholotsho, 2017; Mazvimavi, Twomlow, Murendo, & Tawedzengwa, 2007). Sukume et al. (2000) argue that the difficulty of processing small grains and the hard labor involved in pounding the grain into flour is a major challenge.

In addition, the processing of maize is much more straightforward than the more labor-intensive finger millet. Once the grain of maize is removed from the husk, it is dried and then taken to the hammer mill for processing. However, Muchineripi (2014) reveals that once finger millet is harvested and separated from the sheath, the hard shell of each grain needs to be removed manually by pounding the grain. It is then sieved to remove any sand or sediments present. After this, the grain needs to be roasted and then finally ground into fine powder. If any of these processes are done wrongly, the outcome is a grainy mealie meal which further perpetuates the stigma against producing small grains. Unfortunately, this additional work often falls on the shoulders of women, who contribute to the majority of agriculture labor. While finger millet is cheap to grow, farmers must be willing to invest the necessary additional time (Muchineripi, 2014). A household respondent exclaimed that:

> *There is simply no machinery or technology to process sorghum and millet. We rely on the laborious traditional way of processing sorghum and millet*. (Household respondent 15, Phumula ward)

5.8. Lack of transportation and storage

According to the Food and Agriculture Organization (FAO) (1995), stockholding-related constraints also contribute to the negative factors affecting the development of commercial marketing of the

commercial grain stocks for sorghum or pearl millet. Processors must be willing to purchase and hold these stocks on their own, or they need access to traders willing to take the risk of holding such inventories. Historically, sorghum and millet stocks were held by government grain marketing parastatals. However, when markets were liberalized, these stocks disappeared (though public stocks of maize were commonly maintained). Taylor (2003) further argues that millers experimenting with the production of sorghum meal in Zimbabwe and Tanzania have each complained about running out of sorghum grain stocks months prior to the next harvest. Each country found it difficult to estimate their needs in this evolving market. Since the costs of holding stocks are high, the proclivity of these processors is to hold more conservative levels of stocks.

Nhemachena and Hassan (2007) state that smallholder farmers are located in areas where the transport systems are poorly developed and may not attract investors in strategies such as irrigation. Their income sources are limited and restricted to agricultural production and hence strategies that require capital. Therefore, it can be noted that small grain farmers face a problem of transporting their harvest to the market and also lack of storage facilities by the buyers, pose as a challenge to small grains as a strategy to climate change (Taremwa et al., 2016).

An Agritex official indicated that:

> *Transport and storage for sorghum and millet in this district are not a challenge in the context of scarcity and shortage. The problem is that small grains are locally produced and consumed and have not yet reached a point of spilling over to that other districts. It is only contract farmers who have access to reliable transport and storage facilities outside the district since they are funded by private institutions for the purpose of beer brewing*. (Key Informant Interview, Agritex)

5.9. Marketing challenges

Marketing opportunities are limited for small grains. There are limited formal marketing opportunities for the sorghum, millet, and rapoko, although a lot is being done to support the crops (AGRITEX Tsholotsho, 2017; Gukurume, 2013). The sustainability of seed and grain production hinges on assured markets. Without them, farmers have little incentive to produce. Although efforts have been done by some partners to link farmers to niche markets such as brewing companies—a big consumer of sorghum—as well as non-governmental organizations involved in seed distribution programs in Zimbabwe, it has not yielded significant results. There is clearly a lack of infrastructure to market the buying and processing of small grains, especially in dry areas. It is easily recognizable that there are no shops selling small grain seed; neither are there efforts to promote the buying of small grains. The lack of incentives, subsidies, storage facilities, and effective transport arrangements also discourages farmers from adopting these drought-resistant cereal varieties. A key informant from Agritex commented that:

> *Farmers in Tsholotsho do not have a facility to market their produce for trade purposes. As Agritex office we make efforts to encourage them to produce drought resistant crops but do not go beyond that. This discourages the increased uptake of small grains. The government is yet to prioritize marketing of small grains country wide*. (Key Informant Interview, Agritex)

Rohrcach and Kiriwaggulu (2007) notes that though sorghum and pearl millet are most commonly consumed in various forms of thin and thickened porridge, industrial processing of sorghum and pearl millet meal has been relatively limited. In comparison, maize meal is much more widely produced on an industrial scale—particularly in southern and eastern Africa. There are many reasons for the dominance of maize in these economies, not least the relatively higher productivity of maize production in higher rainfall zones. Rohrcach and Kiriwaggulu (2007) further argues that investments in maize production have also been reinforced by historical market supports favoring maize, including price supports, and stockholding arrangements. Over time, these have encouraged the optimization of maize processing systems. Maize now tends to be more readily available to major millers at prices equal to or less than the price of sorghum. Relative prices for pearl millet

tend to be higher than those for maize. As a result, in many countries, commercial millers are simply unfamiliar with the processing of sorghum and pearl millet, and skeptical about levels of demand (Mallet & Plessis, 2001).

The market incentives for smallholder farmers producing small grains are currently not always there. For instance, Moyo (2011) is of the view that over the past century, patterns of demand and consumption adapted to these investments, with people becoming increasingly reliant on eating white maize. Moyo (2011) bemoans the fact that in many rural areas, the price offered to farmers for small grains by traders is often about 30% of the retail price in towns, whereas it should be at least 60%. The idea of exporting small grains is not even on the cards. According to Moyo (2011) capital investment whether domestic or foreign in small grains are almost non-existent. The only exception to this is when breweries have launched out-grower schemes for sorghum to produce low-cost beer. The vast majority of private finance and credit in Zimbabwean agriculture is still targeted at traditional export crops, such as tobacco and cotton, and the hybrid maize seed industry. In fact, Moyo (2011) further argues that investors are more interested in importing cheap genetically modified maize into Zimbabwe than investing in diverse nutritious foods like small grains and pulses. International donors have not appreciated this reality, nor have they sought to change it.

Muchineripi (2014) observes that in Gutu, a combination of scant agricultural resources and the over-reliance on maize has meant that many rural communities now consume more food than they produce. The regulation and politicization of agricultural markets over the past century has encouraged an assumption that traditional crops no longer have a place in the formal agricultural economy. Where small grains are found, they are grown sporadically. Smallholder farmers are too reliant on maize, at the expense of growing a variety of crops like sorghum and millet that are suited to their natural environment.

6. Conclusion

This paper has examined the reasons for the low adoption rates for small grains as an adaptation strategy against climate change in Zimbabwe. The study establishes that there are a plethora of reasons for the low uptake of small grains as an adaptation strategy to hedge against climate change. One of the main causes of this low uptake is that small grains production in Zimbabwe is affected by high labor costs for land preparation, weeding, bird scaring, harvesting and grain processing compared to maize. Other causes for the general maize preference include lack of technology, non-availability of fertilizers and poor market infrastructure. These factors have resulted in farmers finding maize as a more cost-effective crop to grow even in the face of negative climatic changes. Cultural perceptions have also hindered progress towards a small grains revolution. Local communities generally regard small grains as being associated with poverty. This has been a disincentive in their adoption. Lastly, this study also found out that small-grains generally tend to give comparatively lower yields per land area as compared to maize. This is because of a general lack of investment into the research and development for better and higher yielding local varieties of small grains.

7. Recommendations

The government should take practical steps to teach smallholder farmers in Zimbabwe so that they know that it is strategic to grow and consume food which is suitable for their environments. Not only would this increase food security, but would result in economic growth and development. Further, the government should facilitate and encourage the development of the commodities market of small grains through partnering with the private sector. This market would not only assist in price discovery of small grains, but it would create forward and backward linkages between food processors, financiers, investors, agro-dealers, speculators and farmers to sustain the market of small grains. This study further recommends that government and other stakeholders provide funding for research and development into higher yielding and better tasting small grains varieties that are more acceptable to the market in order to enhance their uptake as an adaptation strategy against climate change.

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