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Full Length Research Paper

Adoption of climate resilient rural livelihoods through growing of small grains in Munyaradzi communal area, Gutu district

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The local people has succumbed to severe recurrent drought in Munyaradzi communal areas ward 21 in Gutu District, which culminated into the majority of them failing to produce good harvest due to adverse effect of climate change. With respect to such social distress in the localities, the study assessed the contributions of small grain crops in alleviation of poverty. The research used both qualitative and quantitative research methodologies to obtain information. The research administered the questionnaires as quantitative research tools. In qualitative methodology, group discussions and in-depth interviews were used to complement questionnaire responses. The research identifies sorghum, and millet, as the small grain crops grown in Munyaradzi communal areas and the rationale being that they are adaptable to climate variability and poor soils. The research also revealed the resistance of these small grain crops to pests and diseases, low inputs requirements and are short seasoned varieties. They are highly recommended to people with HIV, and AIDS because of their high nutritional value. They are useful for social values like, rain making ceremonies and memorial services, oil making and livestock feeds. The research recommends that for small holder farmers to increase their food security, there is need to stop looking at small grain crops just as food crops for the poor in semi-arid regions but as viable food and cash crops that can be commercially produced for domestic and external markets. Furthermore, the research noted that success of small holder farmers depends on development of these crops by private and public sector institutions to ensure the availability of improved seed varieties and widening the range of products and utilization. Failure to promote small grains as advocated by this research the food security situation in Zimbabwe will remain elusive.

Key words: Livelihood resilience, climate change, small grain crops, rural livelihoods.

INTRODUCTION

Southern African rainfall and climatic regimes have been highly variable for the past centuries, characterized by recurrent droughts of varying severity. The droughts were lasting between one and five years (Booth, 1994).The climatic history in Southern Africa is showing changes in climatic regimes, for instance between 1800 to 1830, the region experienced drying up of rivers and swamps and some well-watered plains turned into semi- arid karoos, (Chenje and Solar,1998). They further argued that 1820 to 1830 was a decade of severe droughts throughout Africa. The years 1844 to 1849 were the longest drought spell, lasting 5 years. Rainfall was also decreasing and the years 1875 to 1910 showed a marked decrease in rainfall in Southern Africa, with 1910 experiencing the severest droughts. There were other droughts in 1921 to 1930; 1930 to 1950.

Generally, the climatic regime is showing changes and Table 1 shows the historical over- view of climate in Southern Africa 1800 to 1992 Chenje and Solar, 1998. Climate has been fluctuating between warm, colder, wet and dry periods (Chenje et al. 2002). There have been experiences of prolonged periods of colder and drier periods between 1500 to 1800 AD. These periods recorded 1°C lower than the present temperatures,

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Table 1. A historical overview of drought and rainfall patterns in Southern Africa 1800 to 1830.

Period	Events
1800 to 1830	Southern African rivers, swamps and other water sources dried up. Some well- watered plains turned to semi arid karoo.
1820 to 1830	This was a decade of severe drought throughout Africa.
1844 to 1849	Southern Africa experienced five consecutive drought years.
1870 to 1890	This period was humid in some areas and former lake Ngami filled in the North-West of Botswana
1875 to 1910	There was marked decrease in rainfall in Southern Africa and 1910 experienced a severe drought.
1921 to 1930	Severest drought in the region.
1930 to 1950	Southern Africa experienced dry spell periods. The 1946 to 1947 season experienced severe drought.
1967 to 1973	This six-year period was dry across Southern Africa.
1981 to 1982	Most of sub-tropical Africa experienced drought.
1983	This was particularly a bad drought year for the entire African continent.
1986 to 1987	Drought conditions returned
1991 to 1992	Southern Africa excluding Namibia experienced the worst drought in living memory.
1800 to 1830	Southern African rivers, swamps and other water sources dried up. Some well- watered plains turned to semi arid karoo.

(Karin and Helena, 2006). Drier conditions were experienced starting in 1000 AD to 1200 AD and the climate conditions had been deteriorating due to high population (Karin and Helena, 2006). The development of Great Zimbabwe was heavily hinged to the favourable climatic conditions experienced in the area and its downfall coincided with rapid precipitation and temperature decline at around 1450 AD. There were water shortages and famines (Karin and Helena, 2006).

According to Von Kotze and Holloway (1996), during the 1982 to 1983 season the severe drought in Southern Africa, Sahel and the famine in Ethiopia can be linked to an Elnino occurrence. Again the devastating 1991 to 1992 lasted until February 1992. Some experts say that, about one third of the drought in the region was due to Elnino (The Herald Newspaper, 1993). It stated that Elnino developed at the start of the 1991/1992 rainy season bringing the worst drought of the century to much of Southern Africa. Crops failed and hard-pressed governments spend scarce foreign currency to import food for their people.

According to Booth (1994), scientists predict that global atmospheric changes could disrupt established weather patterns so that existing weather conditions such as drought occur more frequently. The Herald Newspaper (1993) noted that between 1990 and 2007, Zimbabwe experienced the warmest decade. The annual average temperatures increased by 0.4% thereby bringing the number of cold days to a decrease while the number of days with maximum temperature of 30°C to an increase (The Herald Newspaper, 1993). Due to global warming, rainfall declined by 8% leading to increased mid-season dry spell durations. Effort to reduce the effects of climate change in the South emerged in 1996, after the Southern African Development Committee (SADC) held a regional workshop in Harare.

The workshop was aiming to find lasting solutions to the effects of climate change. The 1996 regional workshop promoted the production of small grain crops such as sorghum, pearl millet, finger millet, cowpeas soya beans and groundnuts as panacea to counter the effects of drought. Due to climate change, semi-arid regions need to shift from high water demanding crops to dry land crops because they are more adapted to climate change, and tolerant to poor soils (Carr, 1997). Small grains are camel or scavenger crops because they endure long periods without rainfall and require less plant food hence they mature early. They require fewer inputs as compared to maize varieties, which are too physiological and take between 90 to 200 days to mature hence during drought periods they do not do well as compared to small grains, (Mayhew and Penny, 2008). Chenje and Solar,(1998) posited that the risk and uncertainty brought by climate change such as drought, encouraged society to engineer a variety of contingent responses to drought using a combination of options and diversification of income at household level.

These techniques of improvisation, experimentation, innovation and creativity have been widely used by farmers in Gutu District ward 21. Farmers in Munyaradzi communal area engaged in a number of livelihood diversification as a way of spreading the risk and uncertainty of drought. The most promising option was the move towards promotion of drought tolerant crops.This option seems to be yielding results because they are positively contributing to food security in the area.

Statement of the problem

The importance of small grain crops has been under

played by most communal farmers who prefer to grow maize crops even in marginal areas which is resulting in persistence food shortages in Communal Area especially ward 21, in Gutu District. The above problem persists because most Southern African countries have become accustomed to the taste of maize. Commercialization of the maize crop also forced farmers in marginal lands to grow maize even though their agro-ecological conditions are unsuitable for it, which has resulted in severe shortage of food. Hence, a growing feeling that crop yield and staple food grain production in marginal areas have become highly variable because of this shift.

Justification of the study

The research will give information on the problem of food insecurity, which are a result of climate change and will provide the communities with an understanding of impacts of climate change on their crop production systems and livelihoods. The paper will show how drought tolerant crops are helping farmers in marginal and drought prone areas are addressing the impact of food shortage. This information will be useful to government and NGOs. The government will see how small grains should be promoted in the marginal areas and find ways of improving varieties that can be used by these farmers. NGOs will see how they can promote these drought tolerant crops. The community will see how these small grains are contributing to food security as compared to their larger grain crops.

Aim

To assess the contribution of small grain crops in alleviation of poverty in Munyaradzi Communal areas ward 21 in Gutu District.

Objectives

1. To identify small grain crops grown in Munyaradzi Communal areas;
2. To assess the contribution of small grain crops to food security;
3. To assess the challenges faced by the community in the production of small grain crops;
4. To recommend alternatives to promote production of small grain crops.

CONCEPTUAL FRAMEWORK

Climate regimes are changing and are posing a real threat to peoples' livelihoods and communities already in marginal areas are already affected. The impacts are generally being felt world over and scientists are still studying what might be the major cause. In Zimbabwe, people in agro-ecological region 4 and 5 are feeling the worst of the effect. Those at high risk include people whose livelihood activities are agricultural and more than 70% of the Zimbabwean population fall under this category (Chenje, 1998).

There is a significant change in the rainfall pattern and temperatures and these changes have a dramatic effect on crops grown ground cover vegetation.

SMALL GRAINS CROPS AND THEIR PRODUCTION

According to Chard (2006), Zimbabwe's agro-ecological regions 4 and 5 have a low total annual rainfall averaging between (400 to 600 mm).They often experiences droughts, and severe dry spells. The rainfall is too low and uncertain for cash crops such as maize, which demand high rainfall. Furthermore, the region is only suitable for cultivation of extremely drought resistant varieties such as sorghum and pearl millet (Manzungu, 2000). He argued that the crops are widely recognized as well adapted to semi-arid environments. ICRISAT (1996) maintains that sorghum is a nutritious crop that can survive and grow under harsh climatic conditions and for many years' sorghum and pearl millet were the staple food crops for millions of African people.

Sorghum is the fifth major crop in the world and it is cultivated on about 44 million hectares worldwide, which produce 58 million tones of grain (FAO, 1996). The crop is an important staple food crop in Africa, South Asia and Central America. Kaseke (1996) observed that sorghum is an important drought tolerant food grain crop in Zimbabwe. The crop has greater tolerance to drought compared to maize. It is mainly cultivated in natural regions 4 and 5, which experienced harsh climatic conditions. Chenje and Solar (1998) suggested that people in Chiredzi and Mwenezi adapt to impacts of climate change by growing sorghum, which is more adapted to tropical and temperate climate. It is best adaptive to drought- prone and semi-arid tropical regions. Sorghum is regarded a short-grass Savanna crop. It is tolerant to high temperatures of up to 30°C, (Mayhew and Penny, 2008). Rainfall requirements are very low averaging 300 to 400 mm during the growing season. Its root system is so extensive that it could grow using only the soil moisture without any rainfall.

They also observed that during drought, sorghum roll its leaves inwards to reduce water loss. It tills freely, covering the open ground between the plants thereby reducing soil erosion. Sorghum has deep roots and extensive roots to tap underground water. If the water supply runs short, sorghum can suspend its growth until the supplies resume.Hence, given all the impacts of climate change such as drought, sorghum is the panacea

Table 2. Sorghum mean number of days to maturity.

Variety	Maturity period(days)
Red Swazi	86
Sv2	89
65D	77
Mnondo	101

Source: Manzungu (2000).

because it is good in adaptating to the prone-semi arid tropical regions.

Furthermore, there are many good reasons for growing sorghum in semi-arid areas (Mayhew and Penny, 2008). Sorghum yields comparatively better than maize in such regions. It resists droughts that would kill maize and it takes little from the soil and appears to encourage the development of nitrogen fixing bacteria in the soil.

Inputs requirement for small grain crops

The preparation and planting of small grains, requires a fine tilth ground, (Mayhew and Penny, 2008). Several ploughing and harrowing operations are necessary. They also farther agued that sorghum yields can double if there is deep ploughing. Hickman (1996) observed that sorghum needs fewer inputs as compared to maize. For example in terms of fertilizer requirements, sorghum requires little or no less fertilizer because it tolerates poor soils and need little rainfall. Sorghum needs less fertilizer (Mayhew and Penny, 2008). Furthermore, as the crop matures it should be mulched with dead grass or groundnuts shells in arid areas to conserve moisture and where rainfall is heavier, spread cattle manure or farmyard manure around the plants and they will responds extremely well to this organic fertilizers.

The maturity period for small grain crops

Small grain crops are early maturity crops. According to Manzungu (2000), sorghum matures earlier than maize. He noted that sorghum varieties range from 86 to 101days as compared to 90 to 200 days of maize crops, (Mayhew and Penny, 2008). Table 2 shows the maturity periods of four varieties of sorghum at Chiredzi research station in 1992/1993. Sorghum varieties mature earlier than those of maize do because sorghum varieties range from 86 to 101 days (Manzungu, 2000) as compared to 90 to 200 days for maize varieties (Mayhew and Penny, 2008). The earliest maturing small grain crop matures 4 days earlier than the earliest maturing maize variety and the latest maturing small grain crop matures 99 days earlier than the latest maturing maize crop. Hence, given little amount of rainfall, sorghum varieties will thrive. They are camel or scavenger crops because they take long time without water while at the same time need less plant foods.

Van Slyke (2003) argues that millet is adapted to hot weather and resist drought spell. Under favorable conditions of moisture and warmth, the crop is ready to cut for forage in 6 to 10 weeks. Millet is prone to frost and as such, it has been found as a useful crop to be used on new lands and as a means of controlling weeds because they out compete them. Furthermore, Norman et al (2008) suggested that two types of millet are widely grown in Africa that is pearl millet and finger millet. According to Mayhew and Penny (2008), Bulrush / pearl millet needs 500 to 600 mm of rainfall per annum. The date of the rains is important since too much rainfall at flowering can lead to failure of the crop. Pearl millet requires above 20°C if the grain is to ripen. Pearl millet will grow on poor soils though yields increase on well-drained loams. Moreover, SEEDCO Manual Agronomy (2002) is in line with Van Slyke (2003) who argues that finger millet does well in areas with a minimum annual rainfall of less than 800 mm. It will tolerate dry spells in the early stages of its growth but needs moisture after the first month.

Pearl millet often grows on poor soils but responds well if grown on fertile, well-drained loams. Millet stores very well and is resistant to most pests and diseases. It is a quick maturing crop, which produces grain-bearing side shoots (tillers). Thus, the crop is good for areas with low rainfall because of its good characteristics of being drought resistant and quick maturing. Farmers can get economic returns within a short period and with little rainfall hence, small grain crops have advantages over maize. Mayhew and Penny (2008) posit that pearl millet (Bulrush millet) mature in 100 days and finger millet may take up to a month longer. Given this duration, it is clear that small grain crops are early maturing than maize varieties, which are too physiological in maturity. This advantage of small grains will suit the climate since their early maturity will enable them to thrive well even if the distribution of rainfall is uneven. The fact that millet can thrive well on poor soils means that the crop needs less inputs as compared to maize. For instance, Mayhew and Penny (2008) argue that little preparation of the ground is necessary for pearl millet while finger millet on the other hand needs to have a relatively fine tilth. Millet require thorough weeding until the tillers are established.

All Africa.com (2008) also noted that fertilizers are rarely used on millet because of its cost, but millet needs top-dressing with ammonium sulphate between 15 to 25 cm in height. Van Slyke (2003) also argued that millet does best on rich, mellow, well-drained sandy loams. However, it can grow fairly on rather poor soils. On heavy clays or wet soils, it does not grow well. It is careful prepared, the seedbed made to a considerable depth in order to enable the shallow rootlets to range easy for food. As for millet is distinctly a surface feeder, such as good crop draws large amount of plant-food from a rather limited layer of soil. Furthermore, millet is a scavenger crop, meaning it needs less plant food hence it needs little fertilizer as compound to maize. For small grain

crops, Van Slyke (2003) noted that fertilizer requirement range from 0 to 150 kg/ha as compared to 500 to 600 kg/ha required by maize.

The storage and harvest requirements of small grains are less taxing as compared to those of larger grain crops such as maize. Mayhew and Penny (2008) noted that individual heads of bulrush millet are cut-off manually using sickles or hand knives. Millet store well. Their grains are too small to invite attack by insects. However, this characteristic also means that millet grain dries out very quickly. Unlike maize, therefore millet stores well in most conditions. Many farmers store finger millet without threshing but bulrush millet is threshed before storage. Millet is stored in raised granaries, on house roofs and in wicker baskets. Some farmers use storage pits. The fact that millet grains are too small to invite attack by insects indicates that the grain has an advantage of less cost in terms of storage requirement as compared to maize, which demands costly chemicals to treat the grains against stalk-bores. Hickman (1996) also suggested that millet could be stored for more than 10years without any problems from insects. Van Emden (1989) argues that small grain crops are phonologically resistant to pest and disease than maize. Many small grain crops like sorghum and millet have higher level of resistance to pest and diseases such as nematodes than maize because they protect themselves against wounding by excluding gums latexes and resins (Govereh, 1999).

According to Van Emden (1989) small grains, crops resist pest and disease because most of the varieties have increased density of hairs on leaves, which may deter ovipositor by small insects. Hooked hairs on certain varieties of small grain crops have been shown to trap landing aphids and leafhoppers .Currently, most insects centre on the glandular hairs funnel in wild sorghum .When small insects such as aphids break the hairs in washing over the leaf, the broken hair excludes a fluid which hardens on the insect's legs and mouth parts. Furthermore, Norman et al. (2003) also suggest that some small grains crops are resistance to pest and disease because of their major morphological characters. For example, cowpeas varieties have long pedicles and erect pods to a pod-boring moth (*Maruca testitucalis*).

The resistant according to Van Emden (1989) arises because Larva of the borer penetrates the pods successfully wherever pods are in contact with each other or the foliage.

Production comparison between large and small grain crops

According to Rukuni (2006), Zimbabwe has experienced a number of droughts because of climate change, which affected the maize production base negatively. Droughts of the 1980's and 1990 have showed how vulnerable Zimbabwe's maize production is to drought. The major factor limiting maize yield in marginal areas was drought and poor soils (Mataruka, 1985), Mataruka and Whingwiri, 1988). The report according to the First Round Crop and Livestock Assessment Report released in February 2010 showed that poor rains and hailstorms have affected more than 200 574 hectares of maize of the total 1 723 990 hectares planted. According to this report, 11% of maize crop planted in the 2009/2010 summer season were a complete 'write-off'. People relied on small portions of small grain crops that they had planted. Hence, production of maize during the drought season is far out-weighed by that of small grain crops because small grain crops tolerate low rainfall and poor soils. Thus, Hickman (1996) noted that smallholder farmers in marginal areas should adapt to climate change through production of small grain crops such as sorghum and millet because they can withstand high temperatures of between 20°C and 28°C, altitude of 900 to 1500 and annual rainfall average 650 mm.

Chigume and Shaffer (1989) cited in Kaseke (1996) also shared the same view with Hickman (1996) by maintaining that sorghum and millet are very important food security crops with the potential of reducing famine particularly in low rainfall areas. Mudimu et al. (1988) cited in Kaseke (1996) also argues that sorghum and millet (small grain crops) have greater tolerance to drought than maize and he observed that small grain crops are important drought resistant crops in Zimbabwe. Furthermore, Mazvimavi (1990) cited in Kaseke 1996), highlighted that during good rainy season the production of maize far out -weighed that of small grain crops but during drought season the production of small grain crops is higher than that of maize. Table 3 compares the production of maize and small grain crops during good rainy season and drought season.

Comparison of production between maize and small grain crops

From the table it is clear to see that regardless of the fact that, the small grain crops are planted on a small hectarage as compared to maize they have better yields as compared to maize because they are drought resistant and they can improve food security in marginal areas. Furthermore, results from the 2009/2010 raining season clearly shows the effect of climate change to maize production in which there is rapid decrease of maize production in Munyaradzi Communal Areas in Gutu District. According to Agritex second round crop and livestock assessment, March 2010, maize production was a complete write off in this ward. Rukuni (2006) observed that during three successive seasons of drought from 1981/1982 to 1983/1984 reduced production of maize was about 70% and Zimbabwe had to import maize to improve food security. Furthermore, Zimbabwe also imported maize in 1997/1998 and 1998/1999 while the maize production in the four seasons since 2000 and 2001 have not been good promoting food relief activities from

Table 3. Comparison of production between maize and small grain crops.

Crop	Nov 2008		Dec 2008		Jan2009		Total		
	Area (ha)	Yield (T/ha)	Area(ha)	Yield (T/ha)	Area (ha)	Yield (T/ha)	Area (ha)	Yield (T/ha)	Production (tonnes)
Maize	304	0.8	400	0.6	253	0.4	957	0.6	584.4
Sorghum	9	0.8	6	0.9	7	0.4	22	0.7	15.4
F.Millet	807	0.5	494	0.3	-	-	1211	0.45	551.7
P.Millet	6	0.45	8	0.3	4	0.3	18	0.35	6.5
Total	1126	0.66	908	2.1	264	0.11	2208	0.52	1157.8

Source: Department of Agriculture Technical and Extension Services (Agritex) 2nd round crop and livestock assessment ward level questionnaire March / April 2009.

international community.

According to Rukuni (2006) due to climate change the total production fell to 1.4 million tones in 2000/2001 from the previous season and was only 498 000 tones in 2001/2002. This trend shows that climate change negatively affected maize production. Hence, Olivia Muchena cited in ICRISAT (1996) argues that small grains crops are the panacea to the effects of drought in Zimbabwe in which she maintains that small grain crops play a very important role in farming activities of smallholder farmers.

Nutritional values of small grain crops

Compared to maize, small grain crops have high nutritional values. Nutrients such as carbohydrates and proteins, in both sorghum and millet surpass those of maize. Table 5 shows the nutritional values of maize, sorghum and millet. Acquaah, (2002) observed that small grain crops are recommended for people with HIV and AIDS because they have high content in proteins, which is responsible for improving the immune system .they are rich in nine amino-acids, which are leucine, valine, phenylalanine, theonine, isoleucine, lysine, methionine, cysteine and tryptophan that carry the function of protecting the body. Integrated counseling for HIV and AIDS prevention and care participant's guide (undated) highlighted that they are unpolished foods hence do not loose their nutrients as compared to maize. They contains both micro and macro nutrients needed by the body to stay strong. Table 5 shows the percentage of minimum daily requirements provided by 100 g edible portion of each cereal crop.

The table shows that comparatively a100 g of small grains contain more minerals than that of maize. It has more energy and quantities of minerals such as calcium and iron are more than double. This shows that small grains are very rich in important minerals, which are of vital function of our body. These crops are highly recommended for people with ailing health such as HIV and AIDS infected people. This gives a crop a double function that is of securing food security and that of enhancing the health of our people. The second function becomes the very important in countries such as Zimbabwe where HIV and AIDS prevalence once peaked in every people. Growing of such crops will be very vital to each household.

Promotion of production of small grain crops

ICRISAT (1996) argued that promotion of drought tolerant crops would combat the impact of climate change on rural livelihoods. They believe that the first step towards the promotion of small grains is by stopping to look at small grain crops as food crops for the poor, but to regard them as a viable food and cash crops, which can be produced commercially for domestic and external market. It forwarded that there is need to put efforts and resources into research and development of these crops by private and public sector institutions to ensure the availability of improved seed varieties thus widening the range of products and utilization.

Furthermore, Alumina and Heinrich (2002) argue that regional networks for crop breeding help to promote small grain crops. Individual scientists must commit their time and resources to support regional collaboration. Furthermore, incentive system in the civil service needs to be expanded and linked with the national and regional, markets. The project will explore at least two models of regional breeding involving public and private stakeholders and there is need to strengthen access by regional breeders to the global germ plasma base for targeted crops. According to ICRISAT (1996), policymakers and researchers cannot continue to operate in an environment where they themselves determine the role of small grain crops in the lives of rural people and that this is top-down approach, which is unlikely to lead them anywhere. ICRISAT (1996) argues that farmers in the semi- arid areas who bore the brand of suffering during drought will need sustainable utilization, processing and marketing of small grains. Hence, bottom-up approach is an alternative to achieve total production of small grains where farmers themselves have the right to decide prices of their produce rather than using that of the policymakers and researchers.

The role of policymakers and researchers should remain that of producing enabling environment and encouraged technical services to farmers rather than dictating the market prices of small grain crops. Kaseke (1996) pointed out that promotion of forward delivery contracts, out-grower schemes between community traders and farmers should be promoted to ensure that sorghum, and millet grain of the right quality are supplied to millers. Kaseke (1996) believes that forward contracts and out-grower schemes facilitate the building of good relations between farmers and traders, helps farmers to obtain access to production and extension advice. It also helps to ensure cash inputs such as fertilizers and agro-chemicals. Forward contracts also permit both farmers and traders to lock in future prices and manage price risk thereby encouraging smallholder farmers to engage in small grain crop production in marginal areas.

Rukuni (2006) argue that there is need to improve milling technology and incentives such as duty free import of technologies in order to set up milling and maintenance back-up industries throughout the communal areas thereby making technology for cleaning and processing Small grains as readily available as that for maize. Furthermore, there is need for new-end-uses of small grain crops for example, blending sorghum with wheat flour to produce composites for bakery product, ready to drink beer and malt for home brewing, baby wearing, feeds for livestock and breakfast cereal. Government needs to support research and development of new industrial and consumers' products and processing technologies to create demand. In major sorghum producing countries such as USA and Australia, they are used for stock feed rather than human consumption. This market has significant potential for stimulating demand for small grain farm products. Hence, to improve small grain crops, there is need to develop and encourage more investors to open up industries and factories that process and market small grain crops. Manzungu (2000) argue that development of infrastructure such as roads to transport small grain crops to the markets will facilitate the promotion of small grain crops. Furthermore, irrigation schemes will promote the growing of small grain crops in marginal areas.

METHODOLOGY

In order to explore the demands of this research, both quantitative and qualitative methodologies were used. The questionnaire was the major tool used and these were administered to villagers in Munyaradzi communal areas. It collected information on the small grains being cultivated in the area, hardships faced by farmers and the potential of the crop to ensure food security. Interviews were done with government officials, NGOs and community leaders. It expore more technical issues on constrains and suitability of areas to grow small grains. A sample of 10% of the total population of 3240 people in the ward with 30 villages was used in the research. A systematic sampling was used in the research for the respondents to have an equal chance of being selected in the sample. A computer package called excel was used to analyse the data and the data was presented in graphs, charts and tables.

RESULTS AND DISCUSSION

Small grain crops grown in Munyaradzi communal area

Farmers are growing sorghum, rapoko and millet. Rapoko and sorghum are more popular as 45 and 40% grow the crop respectively. Very few farmers grow finger millet, only 5%. The majority of farmers were growing maize as larger hectarage was given to the crop. The majority of them do not grow small grain crops as the major crop. Comparatively, small grain crops: only 10% on average was reserved for small grain. It therefore means that a lot of hactarage was being put to waste, as the majority of maize crop does not.

Production level of small grain crops as compared to maize

The majority of the respondents suggest that in all years when the area experienced drought, production will always be from the small grain crops maize will destroyed. Officials from Agritex also argued that even using the cost benefit analysis, small grain crops far outweigh that of maize since its production is less costly and easy to manage as compared to that of maize, which need a lot of inputs and close monitoring. The reason why the majority of the respondents tend to produce more on small grain crops is that they are drought resistance; early maturing hence, they can thrive well regardless of the abnormal distribution of rainfall.

The villagers suggest that during the dry season, they produce millet and sorghum, while in the rain season they produce more maize. For instance as in Table 7, below, during 2008/2009 and 2009/2010 season, the majority of villagers got bumper harvest from small grain crops, such as sorghum and millet which contributed significantly to their food security. Although small grains are planted on small hectarage, their yields far out strip that of maize, which is, planted on very large hectarage.In drought years their production further far outstrip that of maize. For example in 2009/2010 year where maize was a complete write-off, small grain crops managed to produce something and this significantly contributed to food security in the area. Officials from Agritex suggest that during 2008/2009 season, most villagers managed to have a bumper harvest from millet, which produced 557.5 tones from 139 hectares planted. Sorghum was second producing 15.4 tones from 22 hectares as compared to 957 hectares, which produced 584.4 tones. Using cost benefit analysis, small grains are far better crops than maize since they require minimum inputs and the produce is high.

During 2009/2010 season, maize crop was completely

write-off and villagers survived through small grains.

Input requirements as compared to maize

The majority of the respondents suggest that apart from being drought tolerant, small grain crops also tolerates poor soils. Some villagers (31.25%) suggested that small grain crops need no fertilizers for example sorghum, rapoko and millet adapt to poor soils. These villagers suggested that small grain crops suited villagers since most villagers do not have capital to purchase inputs such as fertilizers. Most of the officials from GMB and Agritex also argued that small grain crops are camel and scavenger meaning to say they are drought tolerant and need little plant food hence most of the farmers will only apply farmyard manure and cow dung to improve the soil fertility. Furthermore, the villagers said that small grain crops are easy to grow hence need less inputs as compared to maize. For example 11,25% of the villagers suggest that they do not purchase seeds from SEEDCO or hybrids seeds since they do not have capital to buy seeds and other inputs but they use open pollinated crops as seeds and still getting a good harvest.

They also reported that if the same applies to maize, there would be starvation and hunger due to crop failure. Small grain needs very little rotation because these crops have the ability to improve soil structure and texture. In terms of storage, the villagers argued that small grain crops are easy to store and they required less chemicals as compared to maize since they said these could stay long time without treatment.

Level of resistance to pest and diseases

Majority of the villagers argued that small grain crops are resistance to pest and diseases than maize crop. They suggest that sorghum and millet are resistant to nematodes and less susceptible to pests and diseases. The majority of the villagers also argued that they keep their plants free from weed as a way to prevent pests and disease outbreaks. The Agritex officials also indicate that most of small grain crops are resistant to pest and diseases because of their major morphological characters. Agritex officials advised farmers to keep their fields clean and free from weeds as a way to prevent pest and diseases. Villagers said they practice cultural and mechanical methods to protect their plants from diseases through practicing crop rotation that is cheap and easy. In addition, Arex official said small grain crops have higher level of resistance to pest and diseases because most of the varieties have an increased density of hairs in leaves, which may protect and deter ovipositor by small insects. Hence, small grain crops are suitable for the Munyaradzi Communal since the area is sensitive to pests and diseases hence small grain resist to pest and diseases than maize.

Uses of small grain crops

Most of the villagers suggest that small grain crops such as sorghum, rapoko and millet can be used to prepare beer from rainmaking ceremonies (mukwerera) in which every household donate a cup of sorghum, rapoko or millet for that ceremony. They also suggest that traditionally, one who had large quantities of small grain crops have high social status. The villagers also revealed that long back, lobola was paid inform of bags of small grain such as rapoko and millet. Agritex officials interviewed suggest that small grain crops in Zimbabwe are used for beverages such as cereal drinks, which make a nourishing drink, which is served during important occasions like wedding ceremonies and memorial service ceremonies. They also revealed that these drinks or beverages create a sense of oneness and integration amongst community members thereby improves the social well-being of the villagers in Munyaradzi Communal areas.

Challenges faced by villagers in Munyaradzi communal area in their production of small grain crops

The challenges encountered by the community in the production of small grain crops are multifaceted and they include, destruction by the queler birds, laborious harvesting process, which is time consuming, labour intensive and poorly priced at the market. The queler birds are causing a lot of havoc and there is no coordinated control system. People are using rudimentary methods such as chasing the birds and frightening them by beating tins. There is no market for these crops and people are only relying on the local market. This makes it difficult for farmers to grow. They said the ears of millet, rapoko and sorghum plants might not ripen at the same time thus they may have to be more than one harvest; hence, the majority of villagers opted for maize.

Agritex officers also noted that small grain crops need too many processes, which start at planting to harvest and the final preparation into a meal. Hence, most villagers prefer maize crop, which they eat both as green meals and as processed mealy-meal. The researcher also observes that lack of good agronomic practice is another challenge facing the villagers and lead to low production. In ward 21, there is shortage of agronomic experts leading to lack of technical support that depicts the maximum production of small grain crops.

Majority of the villagers complained that government parastatals such as GMB do not provide inputs and services needed by smallholder farmers. Most of the

Table 4. Nutrition composition of maize and small grain crops.

Crop	Function	Contents (%)
Maize	Carbohydrates	73.5
	Fats	4.5
	Protein	9.3
Sorghum	Carbohydrates	75.5
	Protein	9.5
	Fats	2.8
Millet	Carbohydrates	76.8
	Fats	1.4
	Protein	5.6

Source: Mayhew and Penny (2008) adopted from ICRISAT, 1996.

Table 5. The percentage of minimum daily requirements provided by 100 g edible portion of each cereal crop.

Plant	Component	Percentage
Maize	Kilocalories	11 - 8
	Calcium	2 - 7
	Iron	42 - 2
	Vitamin B	14 - 1
	Vitamin C	83 - 0
Sorghum	Kilocalories	11 - 4
	Calcium	6 - 2
	Iron	111
	Vitamin B	15
	Vitamin C	0
Millet	Kilocalories	11 - 2
	Calcium	3 - 8
	Vitamin B	7 - 9
	Vitamin C	0
	Iron	0

Source: Mayhew and Penny (2008).

villagers suggested that lack of technical support and agronomic practice for the low rainfall region is a challenge in the area. Most of them said they plant small grain crops very late and do not apply anything to improve soil fertility hence appealing to the government to nip the problem in the bud before it cause chronic impacts to the area. Since villagers plant their crops using low quality seeds and poor germination rate.

Opportunities in growing of small grain crops

Villagers revealed that most of the small grain crops attract local and foreign agro based industries hence; they generate foreign currency from these crops. The humanitarian organizations like Care, Oxfam and ActionFaim are providing education and technical support to the villagers. They are giving them free seeds and other inputs such as fertilizers to increase food security. All this enables villagers in Munyaradzi to venture into livelihood diversification, which helps to spread the risk of drought by engaging in barter trade, rural trading and beer brewing which improves income and quality of life in Munyaradzi Communal areas. Government of Zimbabwe is providing inputs to smallholder farmers in marginal areas at subsidized rate. The government is providing technology for cleaning and processing small grain crops.

Conclusion

The growing of small grain crops bring about sustainability in rural communities of region 4 of the agro-ecological region of Zimbabwe since they are camel and scavenger crops. Communities under harsh changing climatic conditions must be resilient to climate change through production of small grain crops given their adaptability to climate change, resistant to pest and diseases and tolerance to poor marginal soils and early maturity, hence suitable to the conditions of Munyaradzi communal areas. Due to their high nutritional values, as Table 4 depicts, sorghum and millet have greater value in terms of nutrients quantity and composition as compared to maize despite the fact that they are underrated. Small grain crops are good for people with HIV and AIDS because of their health values. They also enables the villagers in Munyaradzi to diversify their livelihoods into barter trading and beer brewing which enables the villagers to bankroll their income portfolios and income generating activities thereby leading to sustainable livelihoods development. The pandemic

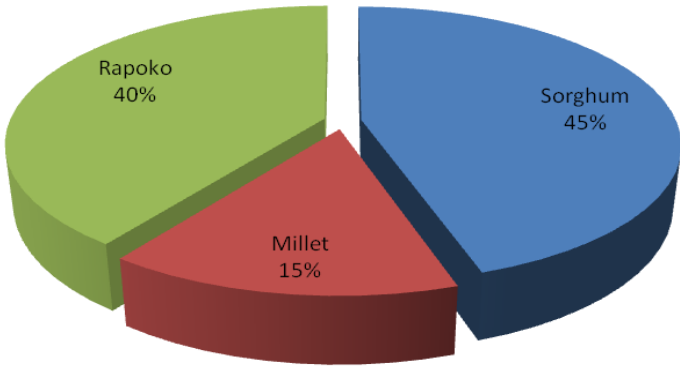

Figure 1. Small grain crops in Munyaradzi communal area. Source: Field Survey, 2010.

Table 6. Production levels of maize and small grain crops during 2009/2010 rain seasons.

Crop	Area (ha)	Yield (t/ha)	Production (t)
Maize	1440		Complete write off
Sorghum	68.34	0.3505	23.95
Pearl millet	56.44	0.0029	0.16
Finger millet	339.4	0.0603	20.47
Cow peas	20.8	0.088	1.83
Groundnuts	209.8	0.153	32.10

Source: Ministry of Agriculture, Mechanization and Irrigation Development. March 2010. Adopted from THE Department of Agriculture and Economic and Extension, Faculty of Agriculture on University of Zimbabwe 1996.

Table 7. Comparison of the production trends of small grain crops and maize during 2008/2009 and 2009/2010 season.

CROP	Total area(ha) 2008 - 2009	Total area(ha) 2009 - 2010	Total yield(t/ha) 2008 - 2009	Total yield(t/ha) 2009 - 2010	Production (tones) 2008 - 2009	Production tones 2009 - 2010
Maize	957	957	0.6	-	584.4	Complete write off
Sorghum	22	68.32	0.7	0.3505	15.4	23.95
F.Millet	139	339.4	0.45	0.0603	557.5	20.47
P.Millet	18	56.44	0.35	0.0029	6.5	0.16
Rapoko	120	229.4	0.40	0.0504	500.57	15.57

Source: Agritex Gutu office statistics, 2008/2009 and 2009/2010.

affecting the region can be handled by the nutritious values of small grain crops and their adaptability to climate change would improve resilience of the rural poor in harsh climatic conditions. With the level of productivity depicted in (Figure 1), communal people in region 4,5 and 6 should reserve a greater percentage of their farm land on small grains than maize since the maize crops proved to be un reliable hence unsustainable. Lack of technical support and good agronomic practice needs to be given priority in the bud to achieve sustainable livelihood and sustainable development. To achieve maximum production of small grain crops there should be cooperation between public and private sector institutions. The government needs to play a pivotal role in providing farmers and traders with good agricultural pricing policies and incentives that promotes the production of small grain crops in marginal areas. Hence small grain crops enhances sustainability in rural communities of the dry agro-ecological regions of Zimbabwe since they are camel and scavenger crops. This is revealed by Table 6 that despite the area covered by maize, small grains with little space produced higher yields showing that they are reliable crops .Maize with its large hacterage, the produce is complete write off which

is unsustainable.

They promote food security and have the potential to overcome shocks such as food shortages hence sustainable livelihood development. Therefore, each household should make half of his or her local field to small grain crop production per each growing season.

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