

Full Length Research Paper

Opportunities, perceptions and challenges in production and use of traditional grains in Semi-Arid Masvingo District, Zimbabwe

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This paper aims to understand farmers' perceptions and challenges in production and use of traditional grains as well as feed manufacturers perceptions on inclusion of traditional grains in feed formulations. The study also seeks to ascertain the opportunities for increased adoption of traditional grains as an adaptive strategy to climate change. Climate change has contributed to a shift in seasons and precipitation, giving rise to successive droughts in Zimbabwe. This has resulted in decreased maize production and productivity semi-arid and arid regions. Traditional grains have the potential to sustain livelihoods and contribute immensely to the feed and breweries industry. Data were collected using 250 semi-structured interviews, 5 focus group discussions and 25 individual farmer interviews in Masvingo District. Ten feed manufacturing companies listed by the Stockfeed Manufacturers Association were also interviewed. The data were analysed using IBM SPSS Statistics ver. 22 of 2019. All tests were tested at $p < 0.05$ significance level. Majority of the farmers (48%) produced traditional grains for consumption and 23% used the grain for livestock feed. The study recommends mechanisation and modernisation of production and processing of traditional grains to further increase adoption by farmers and feed manufacturers.

Key words: Traditional grains, semi-arid regions, sorghum, climate change.

INTRODUCTION

The increase in global warming due to anthropogenic activities is linked to varying rainfall patterns and seasonal patterns as well as increased incidences of extreme weather events such as droughts and floods (Gitz et al., 2016). Climate change and variability is predicted to have adverse impacts in Zimbabwe, making the country drier and hotter particularly in rural areas (Mazuru, 2019; Brown et al., 2012) where approximately

67.7% of the population lives (ZIMSTAT, 2018). Increase in temperatures and changes in rainfall patterns will result in increased incidences of crop failures and reduced productivity ultimately threatening food security (Gitz et al., 2016).

Traditional grains such as sorghum, pearl and finger millet are among the highly ranked staple cereal crops that play a major role in the country's food security

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(UNDP, 2018). Sorghum has been proven as drought tolerant, therefore more ecologically compatible with semi-arid areas compared to maize (Nciizah et al., 2021); Phiri et al., 2019). Sorghum and millet have lower risks of failure in marginal areas due to their drought tolerance making them an appropriate climate change response strategy (Mukarumbwa and Mushunje, 2010).

Production and policy challenges have resulted in low uptake of traditional grains despite expert advice and increasing calls for their production (Gukurume et al., 2010). Traditional grains have remained side-lined and perceived as 'orphan' or 'poor farmer's crop'. Studies have shown that the traditional grains value chains in Zimbabwe are not functioning to their potential because of weak coordination amongst the value chain actors (UNDP, 2018). Limited value addition activities coupled with the availability of maize from local and regional markets at relatively lower prices has continuously pushed sorghum and millets towards extinction from the production, processing, marketing and consumption value chains (Musara et al., 2019).

The feed and breweries industry are the largest consumers of traditional grains. Utilisation of sorghum in feed formulations is however dependent the right price, quality and availability. Sorghum is associated with subsistence agriculture, and this has largely contributed to low availability. Total substitution of maize grain with sorghum in formulation is unlikely due to low availability. The market price does not reflect the value of sorghum as a competitive energy source further disadvantaging the grain. For traditional grains to be effectively used in foods and feeds, production costs and other related costs should enable floor price to be met making their production profitable to the farmer (Wood, 1998).

There is lack of robust research on traditional grains production and utilisation in Zimbabwe, which limits the development of new technologies and practices that could improve production and productivity. The lack of effective demand for traditional grains has also negatively affected their widespread adoption as a climate proofing strategy.

Increased production will only occur if sorghum and millets can cost-effectively and technically replace or supplement maize in commercial food and feed systems. This paper therefore sought to investigate the perceptions, opportunities and challenges in production and use of traditional grains as well as to investigate ways to create effective demand to encourage adoption of sorghum and other traditional grains.

MATERIALS AND METHODS

Study site

The study was conducted in Masvingo District located in Masvingo Province, Zimbabwe. It lies between latitudes 20° and 22°S and longitudes 30° and 32°E. Masvingo district is located in the semi-arid, low-veld south-eastern parts of Zimbabwe with a highly

variable rainfall pattern. The study site receives mean annual rainfall between 550 and 650 mm and a mean temperature of 29°C. The site is characterised by mixed crop livestock production systems with limited crop diversity. Study site map is as shown in Figure 1.

Sampling procedure

The province was selected based on high production of traditional grains informed by the Crop and Livestock Assessment Report (MLAFWRR, 2021). Wards in Masvingo District were purposively selected with the help of AGRITEX extension staff who were knowledgeable on traditional grains production trends in the various villages. The target population was limited to households actively participating in production of traditional grains and 700 households were identified. A representative sample from the target population was calculated using the method by Cochran (1977). Stratified random sampling was used to select wards and households based on productivity levels and willingness to participate in the survey. Names of households producing traditional grains in all selected wards were collected from ward councillors and assigned random numbers generated using a computer. Fifty households were selected from each ward and a total of 250 households participated in the study.

Simple random sampling was used to select farmers to participate in the focus group discussions. One Focus Group Discussion (FGD) with twelve participants selected from the surveyed households was conducted in each ward. From the 12 participants, 4 farmers were selected using purposive sampling for individual interviews. This was done to further probe farmer attitudes, beliefs, desires, and experiences to get an in-depth understanding of social issues. The convergent mixed methods design with the one phase approach was used to collect both the quantitative and qualitative data.

Key informant interviews

Key informant interviews were conducted with feed manufacturing companies registered with Stock Feeds Manufacturers of Zimbabwe (SMZ). Sixteen feed manufacturing companies are registered, and these were targeted to participate in the survey.

Questionnaire administration

Pre-tested semi structured questionnaires were interviewer administered to randomly selected farmers and to registered feed manufacturing companies. The farmer survey questionnaires captured data household demographics, crops grown, and livestock species kept. The key informant questionnaire captured information on level of incorporation of traditional grains in formulations, machinery required for processing and challenges faced by feed companies pertaining to use of traditional grains in their formulations compared to maize.

Data analysis

The data were analysed using IBM SPSS Statistics ver. 22 of 2019. Thematic analysis was used to analyse the qualitative data from the Focus Group Discussion and individual interviews. Descriptive statistics generated focused on contribution of crop and livestock to household income, perceptions on production and inclusion of traditional grains in livestock feed, general use of traditional grains and constraints faced in production and utilisation of traditional grains. PROC MEANS procedure of SAS (2019) was used to

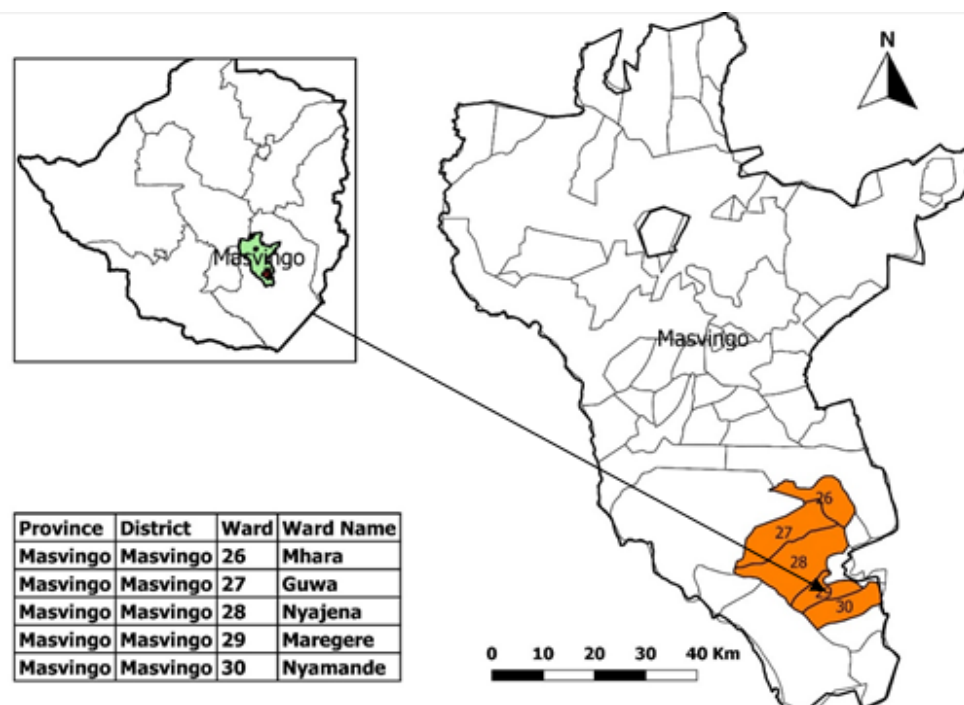


Figure 1. Study site: Masvingo district, Wards 26-30.

estimate means for land holding size, average yields and livestock composition. Chi-square test was used to test for possible associations between variables. All tests were tested at $p < 0.05$ level of significance.

RESULTS

Household demographics

Two hundred and fifty households from 5 Wards in Masvingo district were surveyed. There were more male respondents (65%) compared to female respondents (35%). Most respondents (32%) were between the ages of 40 and 50 years. Land size ranged from 0.3 ha (minimum) to 7 ha (maximum) with average land size of 2.96 ha. Majority (38.6%) of the farmers had been farming on the same piece of land for 2 years whilst only 1.6% had been farming for 5 years. Farmers relied mostly on crop and livestock production. Most farmers (98%) owned livestock with poultry and goats being the most common (Table 1). Farmers relied on livestock for income, meat and draught power.

Farmers ranked maize as the most important crop for income generation, followed by sorghum (Table 2).

Production of traditional grains

Land allocated towards traditional grains production ranged from minimum of 0.1 to 4 ha, maximum. The

average land allocated was 1.13 ha, similar to allocation towards maize production. Average yield per hectare ranged from 0.5 to 0.9 tonnes for traditional grains with sorghum producing better yields followed by pearl millet and the least productive being finger millet (Table 3).

Most farmers (97%) preferred white sorghum to red sorghum. Majority of the farmers (64%) cited that the two varieties were distinctly different hence the preference to grow the white variety. Farmers found white sorghum varieties more palatable, easily marketable and more productive in terms of yield compared to red varieties. The red varieties were most used for beer brewing and were resistant to quelea bird attacks.

Different uses of traditional grains

Majority of the farmers (48%) produced traditional grains for consumption, whilst 29% sold the harvested grain and 23% used the grain for livestock feed. Harvested grain was sold locally with prices ranging between USD 5.00 and USD 15.00/20 kg. Farmers who used grain for livestock supplementation did not process the grain prior to feeding and only 10% reported negative effects on their livestock. Bloat, incomplete digestion and scours were the most common side effects. Low quantities of grain were cited by the majority of farmers (62%) as the main reason for not using traditional grains for livestock feed. A few farmers (7%) cited poor animal performance as reason for not incorporating traditional grains in

Table 1. Type of livestock owned by households.

Type of Livestock	Number of households owning livestock	Total livestock owned
Cattle	208	1239
Goats	213	1331
Sheep	20	107
Poultry	243	4402
Donkeys	16	63
Ducks	1	8
Guinea fowl	23	140
Rabbits	1	3
Turkey	23	218

Table 2. Ranking and average yield of crops contributing to household income.

Crop	Rank	Average yield (ha)
Maize	1	0.9
Sorghum	2	1
Groundnuts	3	0.9
Finger Millet	4	0.7
Cow peas	5	0.4
Sweet potatoes	6	2
Pearl Millet	7	0.7
Sugar beans	8	0.6
Cassava	9	0.6

Table 3. Households growing traditional grains and average yield.

Traditional grain	% Households	Average yield (t/ha)
Sorghum	55.13	1
Pearl millet	20.53	0.7
Finger millet	24.34	0.7

livestock diets.

Opportunities and constraints to traditional grains production

Farmers highlighted that there were opportunities to expand the production of traditional grains in semi-arid regions of the country. Most households were aware of climate change, evidenced by changes in rainfall patterns and increased incidences of long dry spells. As a result, more farmers were opting for traditional grains production as a more conducive option. Traditional grain yields were better compared to maize especially when there were erratic rains. Farmers also cited opportunities to tap into

traditional grains value chains such as feed manufacturing and value addition of food products. Constraints faced by farmers in production of traditional grains were labour related as they experienced a heavy burden in cultivating and weeding compared to maize production. Farmers had limited channels to sell their grain and sold mainly to small scale traders. The low and variable market prices did not support sorghum as a reliable source of household income. Losses by bird attack and post-harvest losses due to lack of proper storage facilities were also some of the constraints cited by farmers.

Feed manufacturers' perceptions

Feed manufacturing companies registered with SMZ were interviewed and 75% had an average of 14 retail outlets. The type of feed manufactured comprised concentrates and straight feeds for ruminants and non-ruminants. Most customers preferred the beef pen fattening meal, beef survival meal and the dairy meal from the ruminant section, whereas the poultry starter, grower and finisher meals were the most preferred from the non-ruminant section. Preference of these products was due to their quality, affordability, and livestock performance. Most feed manufacturing companies (75%) ranked quality as the most important factor when selecting grain and other raw materials for feed formulation. Supplier reputation was ranked the least important (63%) selection factor shown in Table 4.

Use of traditional grains in feed formulation

All respondents (100%) cited red sorghum, white sorghum, pearl millet, finger millet and barley as suitable grain for incorporation in livestock feed. Traditional grains were commonly incorporated in poultry, cattle and horse feed formulations. Majority (67%) of feed manufacturers indicated that inclusion of traditional grains in feed formulations did not require specialised machinery.

Table 4. Grain and raw materials selection factors.

Reason	Rank %				
	1	2	3	4	5
Price	26	53	11	11	0
Preference	0	0	11	63	26
Availability	0	26	53	11	10
Quality	75	25	0	0	0
Suppliers' reputation	0	0	26	11	63

Table 5. Factors prohibiting use of traditional grains in livestock feed.

Reason	Rank (%)				
	1	2	3	4	5
Quantity available	56	28	16	0	0
Price	27	15	24	16	0
Preference	18	50	32	0	0
Lack of knowledge	0	22	0	78	0
Quality	0	0	100	0	0
Lack of specialised machinery	0	0	0	100	0
Suppliers' reputation	0	0	0	0	100

Those that indicated the need for specialised machinery cited specialised sieves and use of different screen configurations for hammer mills due to the small particle size of the grain. The seed coat hardness also required modification of the milling process and required grain to be processed through a roller mill. Respondents confirmed that the required specialised machinery was locally available.

Perceptions on pricing, availability and use of traditional grains

Majority of respondents (67%) indicated that the local price of traditional grains was fair, followed by 22% who indicated the price as expensive and only 11% reported the price as cheap. Most feed manufacturers (89%) found the availability of traditional grains fair whilst 11% reported that traditional grains were not readily available. Quantity of available traditional grains was ranked the most important factor (56%) prohibiting the use of small grains in feed manufacturing and lack of specialised machinery was ranked the least important factor shown in Table 5.

Opportunities and constraints to incorporation of traditional grains in feed formulations

Most (80%) of the feed manufacturers indicated that there are opportunities to carry out extensive research

regarding the use of traditional grains in livestock feed. Majority (80%) of the respondents reported that customers were willing to purchase livestock feed formulated from traditional grains. There were opportunities for feed houses to expand their traditional grains feed range as 75% of the respondents were already using traditional grains in formulations. The major constraints cited by feed manufacturers were the low quantities of traditional grains because of their association with subsistence agriculture, variability in quality and the high content of anti-nutritional factors. Respondents highlighted that negative impacts of anti-nutritional factors could be reduced by use of enzymes and additives. The disadvantage however was increase in cost of feed as enzymes were expensive and their use is still not widely accepted in the country.

DISCUSSION

The production of traditional grains is common in the arid and semi-arid regions of Zimbabwe as an adaptive strategy to climate change (Svodziwa, 2015). This is due to the fact that productivity of maize is highly dependent on rainfall trends whereas traditional grain yields thrive in both wet and dry season (Simba et al., 2012).

The average land under crop production was 1.13 ha and was comparable to that of old resettlement areas as reported by World Bank Group (2017). Other studies also found that farm size was skewed mainly to small-scale production with average land size ranging between 0.1

and 5.0 ha (Yahaya et al., 2022). Phiri et al. (2019) reported an average yield of 0.24 to 0.32 tonnes/ha for sorghum which was lower than the observed yield of 0.5 to 0.9 tonnes/ha.

Most farmers relied on crop and livestock production as a climate change adaptation strategy with poultry and goats being the most common. The traditional grains-livestock integration emerged as the dominant integration system in Matabeleland South province (Musara et al., 2021). The traditional grains-livestock integration system however had numerous limitations resulting in limited uptake of the practice.

Traditional grains have the potential to support livelihoods in semi-arid and drought prone regions in Zimbabwe (UNDP, 2018). The finding that majority of the farmers produced traditional grains for subsistence and augmenting household income is supported by Svodziwa (2015). Traditional grains were also commonly used for brewing traditional beer sold in the informal markets (Svodziwa, 2015). Traditional beer proved to be an important source of household income in the semi-arid regions where production of traditional grains is practiced. The study observed different sorghum varietal preferences, with the red sorghums most preferred. This is in line with findings by Andiku et al. (2021) who noted that farmers in Uganda preferred red sorghum. These observations were however contrary to findings by Miriti et al. (2022) who reported that farmers in Tanzania preferred white sorghum for the production of alcoholic beverages.

The feed manufacturing industry is potentially the largest consumer of traditional grains such as sorghum. The use of traditional grains in livestock feed can provide a market for smallholder farmers, promoting rural livelihoods and reducing poverty. Studies of the sorghum value chain have shown that sorghum has the potential to drive and sustain the stock feed industry. Majority of feed manufacturers in the survey indicated that inclusion of traditional grains in feed formulations did not require specialised machinery. In contrast, Deribe and Kassa (2020) highlighted that different grain inputs require separate machines and techniques resulting in the need for plant expansion and extra investment. A few feed manufacturers from the survey supported this finding and indicated that specialised equipment such as impact mills, pin mills and roller mills were required to breakdown the pericarp of traditional grains such as sorghum. In addition to removing the pericarp, they also highlighted the need to process sorghum grain further to make it suitable for livestock feed.

There is an increasing demand for sorghum-based feed products and opportunity for feed manufacturers to expand their traditional grain feed range. Majority of the companies surveyed were already incorporating traditional grains in their feed formulations. These observations were however contrary to observations by Deribe and Kassa (2020) who indicated the limited

knowledge on utilisation and value creation in the sorghum value chain. In Tanzania, only two feed manufacturers within the medium and large-scale category were utilising sorghum grain for livestock feed production. Some of the leading millers and feed manufacturers had abandoned the use of sorghum due to several reasons which included pricing and availability (Deribe and Kassa, 2020).

Traditional grains offer numerous benefits; however, the use of these grains by farmers and feed manufacturers is still limited. Constraints such as labour shortages, bird damage pests and weed infestations affected the level of traditional grains production (Chamunorwa et al., 2021). Farmers also cited the low productivity to lack of access to improved seed varieties and over reliance on traditional cultivars (Wanga and Shimelis, 2022). Farmers also had limited market channels and most resorted selling their grain to small scale traders due low and variable market prices that did not support traditional grains as a reliable source of household income (Musara et al., 2019).

Feed manufacturers cited low quantities, variability in quality and high content of anti-nutritional factors in traditional grains as major constraints. Most feed manufacturers opted to exclude traditional grains from their formulations due to the unreliable supply despite the high crude protein content and potential to replace maize. Other constraints are centred on pricing as feed manufactures are more interested in price per tonne delivered rather than the general market price (Musara et al., 2019). Rising transportation cost had an impact on pricing of final product as traditional grains are usually grown in marginal areas compared to maize which is grown closer to user industries.

The presence of anti-nutritional factors in grains such as sorghum required the use of enzymes and additives to increase digestibility especially for formulations intended for monogastric animals (Velázquez-De Lucio et al., 2021). The disadvantage cited by feed manufacturers was that of increase in cost of feed as enzymes were expensive. This observation agrees with previous studies by Anyaegbu et al. (2021) who observed that feed manufacturers shunned the use of enzymes due to high cost. There is also still low acceptance of use of enzymes and additives despite other research having proven that their use reduced the cost of production by improving digestion efficiency.

Studies by Rukuni et al. (2006) found that lack of Government support has resulted in maize encroaching areas best suited to traditional grains production. Farmers, however, indicated that the government has made strides in recent years to address this anomaly by offering subsidised inputs for production of traditional grains. These subsidised inputs are being offered in agro-ecological zones not suitable for maize production whilst maize remains optional for the farmer. There have also been concerted efforts to develop a traditional grains

policy that seeks to address issues that limited functionality of the traditional grains value chain (MLAFWRR, 2022) contrary to Svodziwa (2015) who reported the lack of a clear policy that supported small grains production amongst the smallholder farmers in semi-arid and arid regions in Zimbabwe.

There has been increased involvement of government and development partners to come up with labour saving technologies to encourage production of traditional grains (UNDP, 2018), as farmers cited that production and processing of traditional grains was laborious. The study found that there was increased farmer participation to ensure the solutions were client driven to foster adoption and ownership of the technologies. Lack of knowledge is a major constraint to increased production by farmers in semi-arid areas (Gukurume, 2013) and this can be addressed by improved extension services. Extension staff from the surveyed study area highlighted that they had been greatly capacitated through motor bikes and tablets to ease mobility and communication challenges. Capacitation of extension staff ensures farmers adopt climate appropriate technologies and ultimately contribute to increased production of traditional grains.

Farmer Field School (FFS) training is an innovative, participatory and interactive model used in many African countries. The knowledge acquired during the learning process enables farmers to increase their production and productivity as they test and adopt new technologies (Luusa et al., 2018). Government of Zimbabwe through AGRITEX in collaboration with development partners such as the UNDP-Green Climate Fund are conducting FFS trainings in semi-arid regions in a bid to increase adoption of traditional grains. Contrary to Chanza (2018) who reported that traditional grain production has been declining over time despite efforts to promote their production, the Crop and Livestock Assessment report from the 2020/2021 cropping season indicated an increase in total hectareage under traditional grains implying increased production and adoption (MLAFWRR, 2021).

CONCLUSION AND RECOMMENDATIONS

Traditional grains have the potential to support livelihoods in semi-arid and arid regions of Zimbabwe as well as contribute significantly to the feed manufacturing industry. Farmers in Masvingo district acknowledge the change in weather and rainfall patterns and are receptive to the production of traditional grains as a climate adaptation strategy. There is still need however to increase adoption of climate smart agricultural practices among farmers in drought prone areas by mitigating barriers to traditional grains production. Barriers such as by low access to markets, lack of knowledge, pest and disease attacks require value chain wide solutions. These solutions can potentially build resilience and improve livelihoods of communities in drought prone areas. Solutions such as

breeding bird repelling varieties and varieties suitable for food and feed can greatly improve adoption of traditional grains.

The authors recommend concerted efforts to be made towards modernisation of production and processing as well as increase value addition options to make traditional grains more competitive and attractive to the consumer.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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