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ARTICLE

Exploring Constraints and Opportunities for Sorghum Production in Dry Regions of Zimbabwe

Chamunorwa Silas[1] Sakadzo Nyasha[2*] Kugedera Andrew Tapiwa[1]

1.Zimbabwe Open University, Department of Agriculture, Masvingo Region Centre, P. O. Box 1210, Masvingo, Zimbabwe
2.Department of Agricultural Economics and Development, Manicaland State University, P. Bag 7001, Mutare, Zimbabwe

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ABSTRACT

The objective of the study was to explore the constraints and opportunities for small-holder sorghum farmers in dry regions.Two hundred and fifty farmers were sampled by using the simple random and snowball sampling to provide the information that answered the research questions. Questionnaire and interviews were used as the research instruments. Out of 250 participants, 80% were males and 20% were females showing that more males were selected for the research. Data was coded and processed using excel. Descriptive statistics were used to describe results. Of all the participants, 4% were in the age range of 25-30 years, 10% in the age range of 31-35 years, 14% in the age range of 36-40 years, 16% in the age range of 41-45 years and 56% in the age range of 46 years and above. Out of all the participants, 20% attained primary education while 68% had attained secondary education. Only 12% had tertiary education. Results indicated availability of resources (60%) such as certified seed, fertilizers, herbicides and draught power as the major constraint in the production of sorghum. Lack of technical knowhow (20%) of sorghum production, poor farming methods (9.6%) such as mono-cropping, *Striga* weed (12%), outbreak of fall armyworm (14.4%) and marketing of produce (8%) were also amongst the major constraints indicated by most participants. 66% of the 250 participants showed that they produce sorghum due to its drought tolerant nature. Beer brewing was just slightly above half (52%) whilst making mealie meal was slightly below half (48%). Lack of knowledge, resources and poor markets hindered sorghum production in dry regions. Farmers were using retained seeds which are populated and affected by diseases and this contributed to low yields. Opportunities such as reducing poverty, food insecurity and income generation drives some farmers to venture into sorghum production.

**Corresponding Author:*
Sakadzo Nyasha,
Department of Agricultural Economics and Development, Manicaland State University, P. Bag 7001, Mutare, Zimbabwe;
Email: nsakadzo87@gmail.com

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1. Introduction

Sorghum (*Sorghum bicolor* L. Moench) is ranked as the fifth important cereal crop in the world after wheat (*Triticum aestivum* L.), rice (*Orzya sativa.* L) and maize (*Zea mays*. L.) [16,35], with over 80 % of the crop being grown in Africa and Asia. Sorghum is mainly cultivated in the Semi-arid regions where rainfall received is below the average and is intensively grown in continents like Africa, Asia and North America [45,5,25]. The crop is drought tolerant and can be used for alleviating food insecurity in dry regions [24,26]. Sorghum does well in different types of soils and perform best under clay soils which are fertile giving more yields [46].

The crop is useful for food security of households especially in marginalised and dry land areas where rainfall is very low [25] and used as staple food in many African countries including Zimbabwe [26], Kenya [37,24]. Sorghum is a drought tolerant crop which does well in low rainfall areas compared to maize and other cereals as it is ecologically compatible [13,17]. The ability of sorghum to adapt to drought, salinity and high temperature regions can be an advantage of farmers in these regions to use it as food insecurity alleviation [35]. Sorghum have various uses which include staple food, stover for broom production, animal feed, beer brewing [6] and industrial raw material for bio fuel production [35]. Industrially, the grain is used to manufacture wax, starch, syrup, alcohol, dextrose agar and edible oils. There is high demand for sorghum mainly in brewing industry to replace barley, yet the amount produced by farmers is too low to satisfy the market demand [36]. Sorghum can be used in weed control due to production of allelochemicals (cyanogenic glycosides and phenolic acids) which suppress broad-leaved weeds without affecting grass [2]. In Zimbabwe, 62.2 % of the total population of communal farmers lives in Natural Regions IV and occupying 71.8 % of the communal lands [41,46].

Constraints to sorghum production include quelea birds, shoot fly and armoured crickets [6,11] and *Striga* species [35,40]. There is also poor reinforcement of sorghum seed quality control since the crop is treated as peripheral in mainstream agricultural development [19] reported the use of seeds by several farmers from varieties which were grown by their ancestors and did not even know the variety they were growing. Access to working capital remains a challenge in African agriculture since sorghum farmers have no access to credit from banks. Most farmers in the semi-arid regions prefer to grow maize rather than small grains because of their low productivity [7].

Opportunities of growing sorghum include ability to be grown on marginal soils and shorter growing season. Products such as such as porridge, sadza, beer, and livestock feed and fodder are obtained. The lower variable cost of sorghum can help growers spread risk by producing another crop at lower cost and spreading limited capital across more acres. Sorghum is well suited for dry conditions, areas with uneven rainfall distribution that may adversely affect the growing season of other crops and high year to year variations in rainfall and water supplies. Therefore, the objective was to explore constraints and opportunities for small holder sorghum farmers.

2. Materials and Methods

2.1 Study Site

The study was carried out in the ward 11 of Bikita district in the eastern side of Masvingo town, in Masvingo province. It lies between latitude 20 05' 00'' South and longitude 31 37' 00' East. The area is in natural region IV which receives 400-650 mm annual rainfall. The temperature ranges from 18 ^{0}C to 25 ^{0}C. The area is in semi-arid region. The area receives rainfalls which are mainly confined in the summer season – normally from late November to late March-but the rains are at most times unevenly distributed which makes it very difficult for farmers to get good harvests most of the time. The soil is sandy to sandy loam which are inherently infertile. The main agriculture activities are livestock and small grain production.

2.2 Population and Sample Size

The area has a population of 750 households and there are 15 villages. Stratified random sampling method was used to select five (5) villages from the ward. Names of households of all selected villages were collected from ward councillor and were assigned numbers according to each village. Ten (10) households were selected from each village using random numbers generated using a computer. Number corresponding to household name on the village list was selected. If the number was out of range, the process was repeated until the number produced is in the range. Snowball sampling was also used to identify sorghum farmers in the ward and if households were not in the list, they were interviewed to gather more information as these were sorghum farmers who can highlight constraints and opportunities of growing sorghum.

2.3 Research Design

A descriptive survey was used as the research design. It gives a broader range where the questionnaire and interview method of data collection was used. [8] suggested that a descriptive survey method is used because it covers both

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qualitative and quantitative data. Descriptive studies are designed to describe something for example characteristics of users of a given product. Data was collected using questionnaires, interviews and focus group discussions. Questionnaires were pilot tested using households from villages which were not selected to be part of the survey. Face to face interviews were done individually to prevent interference of response by participants.

2.4 Data Analysis and Presentation

IBM Statistical Package for Social Sciences (SPSS) version 25 was used to generate descriptive statistics obtained from questionnaires and interviews. Data from questionnaire were coded for easy analysis. Bar graphs, frequency distribution tables, percentage distributions, means were used as descriptive statistics.

3. Results

3.1 Household Characteristics

Out of 250 participants, 80% were males and 20% were females showing that more males were selected for the research. This shows that most women are not into sorghum production because they consider it to be laborious. Of all the participants, 4% were in the age range of 25-30 years, 10% in the age range of 31-35 years, 14% in the age range of 36-40 years, 16% in the age range of 41-45 years and 56% in the age range of 46 years and above. Out of all the participants, 20% attained primary education while 68% had attained secondary education. Only 12% had tertiary education (Table 1).

Table 1. Demographic characteristics of participants

Characteristics	Frequency(n)	Percentages (%)
Gender		
Male	200	80
Female	50	20
Age (years)		
25-30	10	4
31-35	25	10
36-40	35	14
41-45	40	16
46 and above	140	56
Educational level		
Primary	50	20
Secondary	170	68
Tertiary	30	12

3.2 Major Constraints Faced by Small-scale Sorghum Producers

The 250 respondents who are found to be the producers of sorghum in the questionnaires ticked the major constraints they faced in the production of sorghum as highlighted in the table above (Table 2). Availability of resources (60%) such as certified seed, fertilizers, herbicides and draught power was the major constraint in the production of sorghum. There was lack of NGOs and government support in supplying the farmers with seed. Participants also highlighted constraints such as lack of technical knowhow (20%) of sorghum production, poor farming methods (9.6%) such as mono-cropping, *Striga* weed (12%), outbreak of fall armyworm (14.4%) and marketing of produce (8%) were also amongst the major challenges indicated by most participants. Farmers indicated that they mainly sell sorghum to local markets because they do not have transport to carry their produce to the GMB. GMB also buys the produce but on a smaller scale because of government financial constraints. Some ordinary people especially from nearby places buy the produce for consumption and resell to other places. Some of the participants indicated labour costs (48%) in weeding, harvesting and threshing of sorghum. Sorghum is laborious in terms of production and processing. During the interviews respondents highlighted that from planting to harvesting it requires attention as compared to maize.

Table 2. Table showing constraints in relation to number of farmers facing them

Constraints	Number of farmers facing constraints N=250	Percentage (%)
Availability of resources	150	60
Labour costs	65	26
Lack of technical knowhow	50	20
Poor farming methods	24	9.6
Striga weed problem	30	12
Outbreak of FAW	36	14.4
High plant populations	10	4
Marketing of the produce	120	48
Soil fertility	60	24
Pests and diseases	105	42

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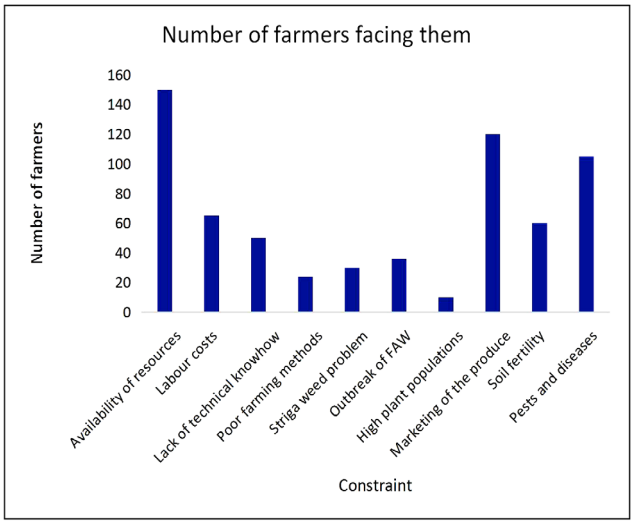

Figure 1. Bar graph showing constraints in relation to number of farmers facing them.

3.3 Major Opportunities for Small Scale Sorghum Producers

Results in Table 3 and Figure 2 below shows that 66% of the 250 participants indicated that they produce sorghum due to its drought tolerant nature. The opportunity of beer brewing was just slightly above half (52%) as indicated by the participants. Slightly below half (48%) of the participants indicated that sorghum can be used in making mealie meal. From the 250 participants, yield assurance as compared to maize in dry areas was slightly below half (46%). Obtained results highlighted that 30% of the respondents noted that sorghum can be used as animal feed. Some of the participants (46%) indicated that there is yield assurance of sorghum as compared to maize in dry areas where rainfall is erratic Results also indicated that income generation (22%) and highly nutritious (10%) were also realised from the respondents. The least opportunities indicated by the respondents were high demand ad fits in all types of soils which scored 4 and 6% respectively.

During the interviews, most producers indicated that sorghum can be stored in for a long time without losing quality; hence it is a major food security crop. The crop can be used for beer brewing and can increase household income through selling beer and also selling the grain to local people. Sorghum has very low cases of pests both stored or field pests and disease incidents. It can even do well on soil with low fertility. Sorghum is nutritious as compared to other cereals.

Table 3. Table showing major opportunities for small scale sorghum producers

Opportunities	Number of farmers ticking the opportunity N=250	Percentage (%)
Drought tolerant	165	66
Livestock feed	75	30
Making mealie meal	120	48
Low storage costs	25	10
Income generation	55	22
Fits in all soil types	15	6
Seeds can be retained and used for many years	25	10
Beer brewing	130	52
Good substitute for maize	35	14
High demand	10	4
High nutritional value	25	10
Yield assurance as compared to maize in dry areas	115	46

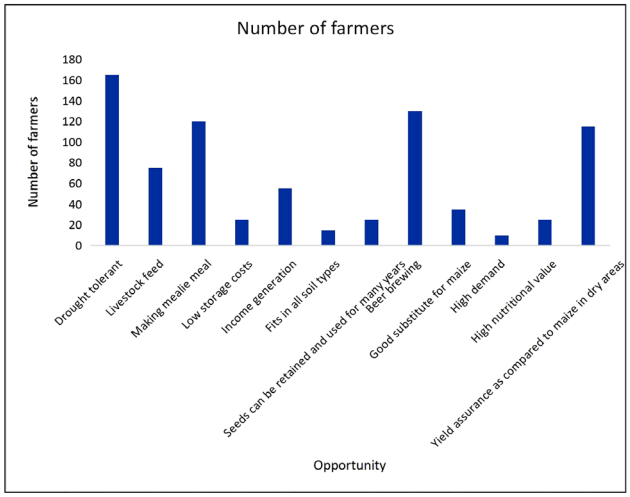

Figure 2. Bar graph showing major opportunities for small scale sorghum producers

4. Discussion

4.1 Constraints to Sorghum Production

Soil infertility and lack of knowledge about growing of small grains has been a major challenge which farmers failed to explore and this was witnessed by poor yields. Results were affirmed by [4] who highlighted the need for education especially the young generation. Farming of

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small grains like sorghum requires morphological and botanical knowledge especially during weeding time as it tends to have weeds that look exactly like the plant such as *Sorghum halepense* [21]. Many assume that once the crop is planted, it grows up to harvest without weed control. Lack of fertilisers use on small grains by farmers caused low yields. This coincides with findings by [1] and [28]. Several studies have indicated that most farmers in Su-Sahara Africa do not use fertilisers in production of crops [22,23,36] leading to realisation of lower yields [10,42]

In previous years, government support on small grains were very little and this affected sorghum production with many farmers preferring maize which fails almost every year in semi-arid and arid regions. This is supported by the [15,18] which reports 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. Results concurs with findings by [15,31,32,45] who noted that government policy and agricultural services target maize production, aggressive marketing by seed houses and millers, favourable pricing policies and good demand [32,45]. [35] indicated major constraints of sorghum which include pests (birds), diseases, drought, *Striga* weed, low yields and marketing. *Striga* constraints were also concurring with report by[40] who reported that *Striga* species are one of the worst weed in cereal production including sorghum. Pest such as birds were also a major constraint in sorghum production especially at grain filling stage. This causes low adoption by farmers. This was in support of results by [27,45] who all reported negative effects of birds on sorghum production and other small grains including millets. The results were also supporting reports by [11] who reported that quelea birds are dangerous in sorghum production as they reduce yields sometimes to zero.

Sorghum producers were also facing lack of resources such as seeds and labour especially during harvesting and threshing. Farmers end up using retained seeds which are polluted and have been affected by diseases causing low yield per unit area. This was in support of results by [7,43]. High labour demand for harvesting, threshing and winnowing was also a constraint for sorghum production since there are few people in rural area and many of them are of old age. This was supporting ideas by [3] who reported high labour cost. Lack of market also affected sorghum production as most people in better regions prefer maize than sorghum. Limited marketing opportunities for sorghum in Zimbabwe especially white varieties are at high. This was supporting results by [1,21] causing many farmers to grow sorghum for own consumption or others shifting to maize production [29,30]. Most smallholder farmers are resource poor farmers who lack resources such as transport to transport sorghum over long distances in search of market. This concur with findings by [39] who reported high transport costs to GMB and affirmed by [44] who indicated that transport cost is a major challenge to smallholder farmers.

4.2 Opportunities for Sorghum Production

Since sorghum is drought tolerant and can be grown in all soil types, this brings in many opportunities such as poverty reduction, food security, and income generation, substituting maize in stock feed production [21,25] and reducing pressure on maize for food. These coincides with results by [12] and [35]who reported that sorghum can be used as food insecurity alleviation in drought prone regions in Africa and other continents. The idea was also supported by [17,31,45] who all indicated that sorghum production reduced poverty and food insecurity in many countries including dry regions of Zimbabwe. Sorghum together with other small grains can be adopted by farmers to reduce malnutrition, death by hunger and food insecurity in many countries across the world [[9,14,17,20,26].

5. Conclusions

Lack of knowledge, resources, markets and inadequate availability of certified seeds to smallholder farmers reduces sorghum production and number of farmers who adopt sorghum as a source of human food. Sorghum production in smallholder farmers could have been at a high level if government support for small grain production was introduced earlier than later especially in drought prone regions of Zimbabwe. Failure by researchers to provide government with information on small grain production as climate risk alleviation in areas which receive low rainfall also hindered sorghum productivity. Sorghum was cultivated by many smallholder farmers in early years but lack of support, markets, outbreak of quelea birds and high labour costs reduces burden on old aged farmers hence opting for maize. Although sorghum has opportunities such as income generation from beer brewing, substituting maize in stock feed manufacture, reducing poverty and food insecurity in dry regions, farmers are opting for maize due to many constraints than opportunities. To increase sorghum production in drought prone regions, there is need for government to support small grain production, provide certified seeds to farmers and market as well as training farmers about how to sustainably grow sorghum.

Conflicts of Interest

Authors do not declare any conflicts of interest.

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