Global Journal of Agricultural Research
Vol.4, No.1, pp.52-57, March 2016
Published by European Centre for Research Training and Development UK (www.eajournals.org)

SORGHUM PRODUCTIVITY TRENDS AND GROWTH RATE FOR LESOTHO

Sekoli M. M. S. and Morojele M. E.

National University of Lesotho, Faculty of Agriculture, Department of Crop Science, P.O.Roma.180. Lesotho.

ABSTRACT: *Aims of paper were: to compare area planted and harvested sorghum; determine production trend over the time-period of 53 years; estimate productivity trend and growth rate; and compare National Cereals supply–demand balance. Time series data collected from FAOSTAT and Bureau of Statistics spanning 1960 to 2013 were subjected to GENSTAT for statistical analysis. Results showed persistent decline in area planted and harvested. Area under sorghum cultivation, production and yield fluctuated erratically throughout study period. Production decreased from 84 000 tonnes in 1975 to 22 000 tonnes in 2010, with only 18% of the period recording yield above 1 tonne ha^{-1}. Increase production area did not always translate into higher yield. Despite low yield, sorghum utilization was 16 000 tonnes compared to 11 000 tonnes produced, thus necessitating an import of 5 000 tonnes, thus there was higher sorghum self-sufficiency level. Promotion of sorghum production and its use should be revisited to address food security and export value.*

KEYWORDS: Sorghum, Trend Analysis, Growth Rate, Lesotho.

INTRODUCTION

Grain sorghum (*Sorghum bicolor* L. *Moench*) is valued worldwide for its grain, stalks and leaves. It is one of the most important cereal crops and in the supply of food energy. It ranks fifth with only four other starchy crops namely, maize, rice, potatoes and wheat, consumed more than sorghum (FAOSTAT, 2013). Sorghum is the most popular staple food for people throughout the world especially in Asia and Africa where it is mostly grown at subsistence level. Sorghum is adapted to grow in hot, arid and semi-arid climatic conditions (Doggett, 1988). In impoverished countries, it is often grown with limited or no fertilization.

Due to its tolerance of a wide variety of climatic conditions, sorghum production is one of the principal contributors to food security of the rural populations (Department of Agriculture, Forestry and Fisheries, 2014). Sorghum is an important dietary component in Africa and Asia where it is used for porridge-making, sorghum flour, bread-making, beer-brewing and traditional dishes. It is also an important source of feed for livestock particularly during the dry season (Ashok *et al*., 2011). The main constituents of sorghum are starch, proteins, unsaturated lipids, minerals and vitamins (Schober *et al*., 2005). Sorghum starch, proteins and unsaturated lipids are digested at a slower rate than in other cereals. This reduced digestibility positively impacts on gut micro-organisms and issues related to obesity, diabetes, oxidative stress and hypertension (Dykes and Rooney, 2006). Other uses include incorporation of sorghum stems and foliage into livestock feed and extraction of molasses.

Productivity of sorghum in Lesotho is generally low with yield of 1 ton ha^{-1} and the crop ranks third in preference after maize and wheat. The national average production in Lesotho is approximately 1 ton ha^{-1} and the yield fluctuates from 0.5 ton to 1.5 ha^{-1} (Bureau of Statistics, 2013). The current yield level lags behind South African yield at 2.4 tonnes ha^{-1} in 2013

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

(Department of Agriculture, Forestry and Fisheries, 2014). Sorghum production in Lesotho has to be promoted due to its' ability to adapt to arid and semi-arid conditions and low input growth requirements as opposed to other cereal crops that require high level of inputs which are unaffordable by smallholder farmers. Under prevailing conditions of intensive and prolonged drought spell, and highly unpredictable weather brought about by climate change, sorghum should be incorporated into the cropping system of Basotho farmers.

The aims of the paper were four-folds; (1) to compare area planted and harvested sorghum, (2) to determine production trend over the time-period of 53 years, (3) to estimate productivity trend and growth rate of sorghum and, (4) National Cereals supply–demand balance.

METHODOLOGY

The study was designed to track the trend of sorghum production and yield over a period of 53 years from 1961 to 2013. Time series data of total sorghum production and yield in tonnes per hectare were obtained from Food and Agriculture Organization of the United Nations (FAO), statistical database (FAOSTAT). The supplementary data were obtained from other sources such as Bureau of Statistics (BOS). These data were subjected to GENSTAT version 18 to perform the analysis under-mentioned.

An assessment of the productivity trend (quantity of crop produced per unit area harvested) was performed by analyzing area planted and harvested, yield and yield growth rate. Linear trendlines were generated to determine the productivity over the study period. Linear function was chosen (out of linear, polynomial, exponential and logarithmic functional forms) over other functions as it gave the best fit in terms of magnitude of coefficient of determination (R^2).

RESULTS AND DISCUSSION

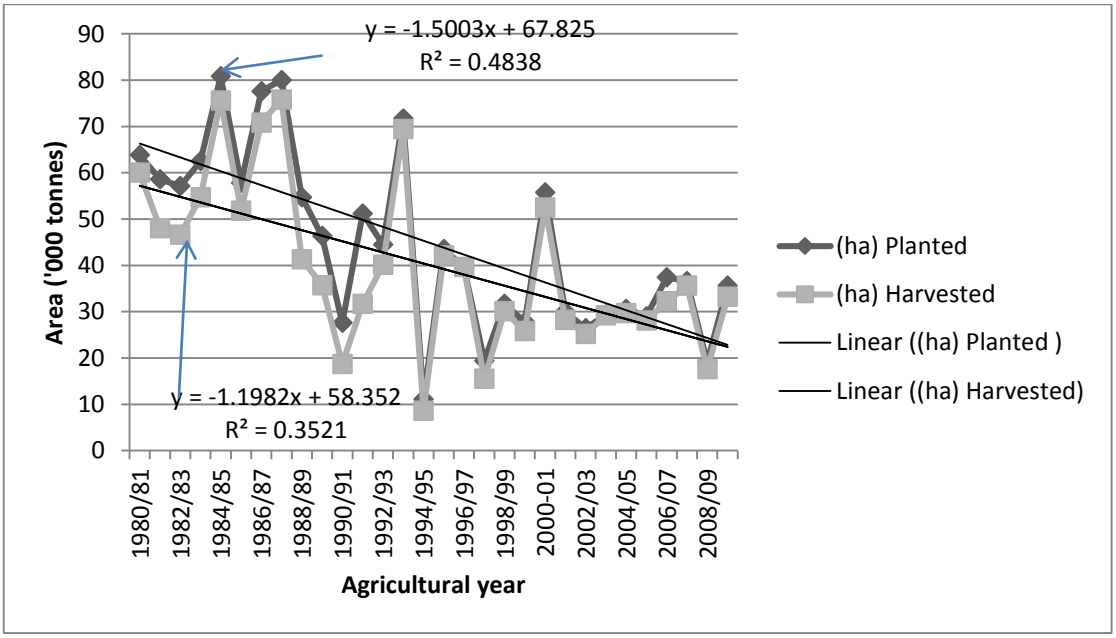

Figure 1. Planted and harvested areas of Sorghum from 1961 to 2013.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Results of the study as depicted in figure 1 indicated that area planted to sorghum was closely aligned to the area harvested over the period 1980/81 to 2009/10, thus indicating that almost all area planted was successfully harvested. Both area planted to sorghum and harvested showed peaks and troughs throughout the period of study. The area under sorghum cultivation declined from 64 000 hectares in 1980/81 to 35 000 hectares in 2009/10 while the area harvested was 60 000 to 33 000 hectares, respectively. Major peaks in sorghum planted area occurred during 1984/85, 1986/87 and 1987/88 at 81 000, 78 000 and 80 000 hectares respectively. The lowest area planted to sorghum was in 1994/95 with 11 000 hectares planted and 8 500 hectares harvested. Maikasuwa and Ala (2013) also noted variability in the area of sorghum production in Nigeria. However, the instability was relatively low at 2.31%. The coefficients of determination (R2) values in the present study were 0.4838 and 0.3521 for area planted and harvested, respectively. This indicated time as a trend variable was important and accounted for 48% and 35% of the variation in area planted and harvested.

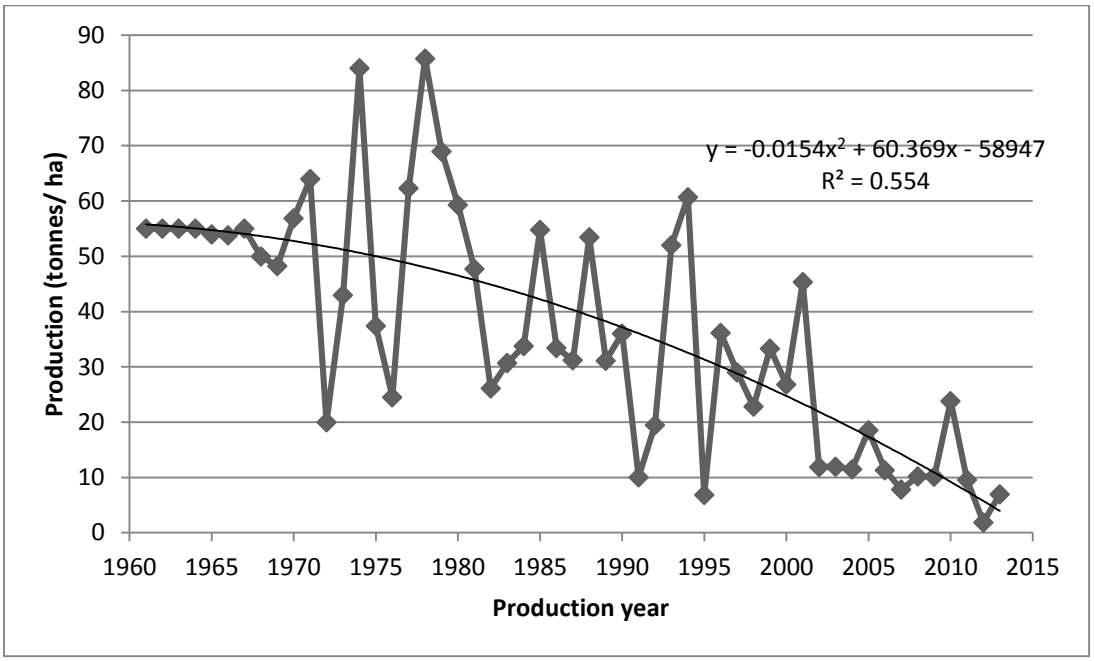

Figure 2. Sorghum production in Lesotho

Production trend of sorghum from 1961 to 2013 is shown in figure 2. Sorghum production had similar erratic peaks and troughs exhibited by area planted and harvested. The highest productivity was in 1978 at 86 000 tonnes followed by 1974 at 84 000 tonnes, 1979 at 70 000, 1971 at 64 000, 1977 at 62 000 and 1994 at 61 000 tonnes. Low production years were 1972 and 1976 at 20 000 and 24 500 tonnes, respectively. The second trough was in 1991 at 10 000 tonnes and 1995 at 6 900 tonnes, annually. From 2000 to 2013, production remained very low with annual tonnage below 10 000 for all the years. The period of study was characterized by high variability in sorghum production. The high level of productivity was consistent with the findings of Maikasuwa and Ala, (2013) when determining sorghum productivity in Nigeria.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Table 1. Productivity trend and growth rate of sorghum in Lesotho from 1961 to 2013.

Year	Production (metric tonnes)	Yield (metric ton ha^{-1})	Growth rate (%)	Year	Production (metric tonnes)	Yield (metric ton ha^{-1})	Growth rate (%)
1961	55000	0.85		1986	33458	0.64	-12.3
1962	55000	0.85	0	1987	31232	0.44	-31.3
1963	55000	0.85	0	1988	53447	0.70	37.1
1964	55000	0.85	0	1989	31140	0.77	10
1965	54000	0.93	+9.41	1990	36062	1.01	31.2
1966	53800	0.83	-10.75	1991	10043	0.54	-53.5
1967	55000	0.83	0	1992	17468	0.61	13
1968	49983	0.71	-14.46	1993	51996	1.27	208.2
1969	48268	0.67	-5.36	1994	60725	0.88	-69.3
1970	56897	0.69	2.98	1995	6887	0.80	-9.1
1971	64000	0.75	8.7	1996	36129	0.86	7.5
1972	20000	0.33	-44	1997	29050	0.81	-5.8
1973	43000	0.67	203.03	1998	22814	1.48	182.7
1974	84013	1.01	150.75	1999	3334	1.11	-25
1975	37443	0.68	-33	2000	26809	1.04	-6.3
1976	24540	0.55	-19	2001	49350	0.86	-17.3
1977	62313	1.47	267.3	2002	11919	0.42	-51.2
1978	85775	1.45	-1.4	2003	11954	0.47	11.9
1979	68952	1.35	-6.9	2004	11482	0.39	-17
1980	59285	0.97	-47.2	2005	18527	0.62	159
1981	47729	0.80	-17.5	2006	11326	0.33	-46.8
1982	26158	0.54	-32.5	2007	7837	0.24	-27.3
1983	30687	0.66	22.2	2008	10189	0.29	20.8
1984	33768	0.62	-6.1	2009	10151	0.58	200
1985	54823	0.73	17.7	2010	23830	0.72	124.1

Production of sorghum and yield for the period 1961 to 2010 is shown in table 1. Both the production and yield fluctuated erratically throughout the period of study. The average yield of sorghum was 1 ton ha^{-1} with yield exceeding this amount recorded in only 18%, nine out of fifty years in the study period. The highest production at 85 800 metric tonnes in 1978 gave the yield of 1.45 tonnes ha^{-1}, which was exceeded by yield of 1.48 tonnes ha^{-1} at production of 22 800 metric tonnes in 1998. This lower yield is in contrast with South African average of 2 to three 3 tonnes ha^{-1}in 2013 (Department of Agriculture, Forestry and Fisheries, 2014). The periods of comparatively higher yield namely, 1977 to 1979 and 1998 to 2000 did not coincide with high production. The data shows a decline in yield rather than an increase and might be related to the subsistence nature of sorghum production in Lesotho. Overall, there was a persistent decrease in production and yield over the period studied. The decline originated from the reduction in production area, yield as well as a combination of yield and production area. Deb *et al*., (2004) suggested that the decrease in average world sorghum production in the 1990's compared to 1970's was mainly due to a decrease in area under sorghum production. In general, they postulated that the main sources of change in average production were: changes in mean yield and or changes in mean area; interaction arising from simultaneous changes in

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

mean yield and mean area; and changes in variability in area and yield. Low sorghum yields and the subsequent food insecurity were found to emanate from low technical efficiency of smallholder farmers in Kenya (Chepng'etich *et al*., 2014), which was similar to other African countries. The inefficiency mainly involved underutilization of sorghum inputs and resources.

Table 2. Lesotho National Cereals supply–demand balance, April 2007 – March 2008 (in '000 tonnes).

	Type of cereal crop				
	Maize	**Wheat**	**Sorghum**	**Rice**	**Total**
Domestic availability	**64**	**27**	**11**	**0**	**102**
Opening stocks	13	17	0	0	30
Production	51	10	11	0	72
Total utilization	**238**	**92**	**16**	**13**	**359**
Food use	226	85	15	13	359
Other uses (pH losses, seed, feed)	3	0	1	0	4
Closing stocks	9	7	0	0	16
Import requirements	**174**	**64**	**5**	**13**	**256**
Anticipated commercial imports	142	64	0	13	219
Confirmed Food Aid	7	0	0	0	7
Uncovered Deficit	25	0	5	0	30

Table 2 indicated the availability, utilization and import of major cereals in Lesotho for the period 2007 to 2008. Domestic consumption surpasses available cereals to meet food use. Sorghum utilization for the period was 16 000 tonnes compared to 11 000 tonnes produced, thus necessitating an import of 5 000 tonnes (FAO/WFP, 2007). In contrast, the deficit for maize was 174 000 tonnes followed by wheat at 64 000 tonnes. The national production of sorghum meets 69 percent of the total requirements. In general, cereal consumption follows the same trend as production as evidenced by annual consumption of 120 kg maize, 45 kg wheat and sorghum 8 kg. Overall per capita food consumption of sorghum in India declined during 1999-2005 and alternative uses increased during the same period (Rao *et al*., 2010) Despite extensive research in sorghum it is considered a secondary grain to maize and wheat and of value mainly to subsistence farmers in arid areas (Wood *et al*,. 2005). With limited demand for sorghum, there is limited production, therefore high and sustained demand for sorghum will lead to higher production (Gourichon, 2013).

CONCLUSION

The trend for national sorghum planted area indicates that the area steadily declined from 80 000 hectares planted in 1974 to a low of 20 000 hectares in 2010 (Bureau of Statistics, 2007). The yield has remained stagnant at approximately 1 tonne ha^{-1} with persistent low yield less than 0.6 tonne ha^{-1}. The yield of sorghum did not tally with production area, thus increase in area planted to sorghum did not necessarily translate to increased yield. The consumption of sorghum is low in tandem with production and subsequent yield. The reasons for the low production and yield are not self-explanatory as an increase in area planted to sorghum did not translate to increased yield. With the current climate change scenario where drought and

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

temperatures are expected to increase, the potential sorghum cultivars should be revisited with a view to increasing food security and export potential and to inform policy action

REFERENCES

Ashok K., Reddy, B. V. S., Sharma, H. C., Hash C. T., Rao, P. S. and Reddy P. S. (2011) Recent advances in sorghum genetic enhancement research at ICRISAT, American Journal of Plant Sciences 2: 589 – 600.

Bureau of statistics (2007) Lesotho agricultural situation report, 1981/82 – 2004/05, Ministry of Finance and Planning, Maseru, Lesotho.

Bureau of Statistics (2013) Lesotho agricultural situation report, 2011/12 Ministry of Finance and Planning, Maseru, Lesotho.

Chepng'etich, E., Bett, E. K., Nyamwaro, S. O. and Kizito, K. (2014) Analysis of technical efficiency of sorghum production in lower eastern Kenya: a Data Envelopment Analysis (DEA) approach, Journal of Economics and Sustainable Development 5 (4): 58 – 65.

Deb, U. K., Bantilan, M. C. S., Roy, A. D. and Rao, P. (2004) Global sorghum production scenario, In: Sorghum genetic enhancement: research process, dissemination and impacts. (eds, Batilan M. C. S., Deb U. K., Gowda C. L. L., Reddy B. V. S., Obilana A. B. and Everson R. E.) International Crops Research, Institute for Semi-Arid tropics, Andhra, India, pp 21-38.

Department of Agriculture, Forestry and Fisheries, (2014) Trends in the agricultural sector, 2013, Department of Agriculture, Forestry and Fisheries, Pretoria, Republic of South Africa.

Doggett, H. (1988) Sorghum, Longman Scientific and Technical, London, UK.

Dykes, L. and Rooney, L. W. (2006) Sorghum and millet phenols and antioxidants, Journal of Cereal Science 44: 236 – 251.

Food and Agriculture Organization of the United Nations, (2015) FAO Statistical databases. http://faostat.fao.org, (accessed Sept. 2015).

FAO/WFP, (2007) Special report: FAO/WFP Crop and food supply assessment mission to Lesotho, FAO Corporate document repository, www.fao.org/docrep, (accessed Mar, 2016).

Gourichon, H. (2013) Analysis of incentives and disincentives for sorghum in Nigeria, Technical notes series, MAFAP, FAO, Rome.

Maikasuwa, M. A. and Ala, A. L. (2013) Trend analysis of area and productivity of sorghum in Sokoto state, Nigeria, 1993 – 2012, European Scientific Journal 9 (16): 6- 75.

Rao, P. P., Basavaraj, G., Ahmad, W. and Bhagavatula, S. (2010) An analysis of availability and utilization of sorghum grain in India, Journal of SAT Agricultural Research 8:1-8.

Schober, T. J., Messerschimidt, M., Bean, S. R., Park, S - H., Arendt, E. K. (2005) Gluten free bread from sorghum: quality differences among hybrids, Cereal Chemistry 82 (4): 394 – 404.

Smith C. W. and Frederiksen, R. A. 2000. Sorghum: origin, history, technology and production, John Wiley and Sons, London, UK.

Wood, J., Hammond, L. and Swetman, T. (2005) Perceptions on sorghum and millet production and utilization in the SADC region and future research needs, Process Quality Management Group, Food Security Department, Natural Resources Institute, UK.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)