
COMPARATIVE ANALYSIS OF CEREAL CROP PRODUCTION GROWN IN LESOTHO

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ABSTRACT: *Production of cereal crops is a thriving industry in Lesotho comprising of maize, sorghum and wheat. The percentage change in composition of these cereal crops in terms of production, yield and area is not well documented. The objects of study were therefore to (i) compare the changes in the composition of cereal crops and (ii) determine trend in area, production and yield from time-period 1961-2017. The secondary data collected from Food and Agriculture Organization (FAOSTAT) was used for analysis. The study was carried out at Maseru in Lesotho. Data were subjected to Excel in the Microsoft office software version 10. The results of study showed that maize was dominating sorghum and wheat in production, area planted and yield. Maize constituted 61% of cereal production; yield productivity was 60% and area occupied 65%. Sorghum production comprised 22%, yield 34% and area 24%. The last performer was wheat with production of 17%, 11% area and 6% yield. It can be deduced from results that maize is most preferred, followed by sorghum and then wheat lastly.*

KEYWORDS: cereal crops, production, trendline, area, yield.

INTRODUCTION

Cereals are crops belonging to grass family known as Poaceae which is also called Gramineae. Family members usually have tall, thin to thick stalks, such as wheat, rice, maize and sorghum whose starchy grains are used as food (Muyambo, 2018; Dyke, 2019). They are cultivated annually world-wide for human and animal consumption. Most of them produce high yields per hectare (Grundy, 2018). Once harvested, their excellent storage stability combined with their nutritional value makes them the most desirable foods for holding in reserve (FAO, 2016). Total annual production is in excess of 2000 million tons compared with less than 700 million tons for root and tuber crops, and about 380 million tons for legumes and oil seeds (Gallagher, 2014; Orr, 2016).

Cereal crops are adapted to a wide range of environmental conditions including adverse soil and climatic conditions. They can be grown in tropical lowlands all year round and in temperate climates during the frost free season (Acquaah, 2015). Warm climate cereals such as sorghum adapt to arid conditions, while cool season cereals such as wheat adapt to temperate climates (Dyke, 2019).

Cereal crops are rich source of carbohydrates (75%), fats (5%), oil and proteins (6 -17%), vitamins (60%) and minerals (30%). In general, cereal crops represent 60% of calories and 67% of proteins consumed by human being worldwide (Ahmad, 2013). Cereal crops are the staple food in developing countries, providing them with about 75% of caloric intake and about 67% of their total protein. As human food, cereals are usually marketed in raw grain form or as ingredients of food products (Williams, 2015). As animal feed, they are consumed mainly

by livestock and poultry, which are eventually rendered as meat, dairy and poultry products for human consumption (Sarwar *et al*, 2013). They are also used industrially in the production of a wide range of substances, such as glucose, adhesives, oils and alcohols (Gwirtz, 2014). Cereals provide more food for human consumption than any other crops.

Due to over-production of cereals and advanced technology in seed production, tillage, sowing, harvesting and storage, cereals can be used as cheaper source of energy affordable by many people. The damaged grains are used for ethanol production (Suresh *et al*, 2019).

In Lesotho, cereal production is the most thriving industry in Agriculture comprising of maize, sorghum and wheat (Sarwar *et al*, 2013). Cereal production for the 2005/06 season was forecast at 126,170 tons comprising of 102,999 tons of maize, 5,635 tons of wheat and 17,847 of sorghum. This represented a 6% increase over last year's output and 96% of the five year average. The output was a result of generally abundant, but late and heavy rainfall, combined with reductions in the size of area cultivated, decrease in the use of fertilizer and decline in the use of improved seed (Food and Agriculture Organization, 2012).

There was a significant regional production variations with farmers in the Northern Lowlands obtaining a very high production compared to farmers in the Mountains and Senqu River Valley areas, where a low production was experienced. In 2014, cereal production for Lesotho was 108,516 metric tons (Morojele and Sekoli, 2016). Though Lesotho cereal production fluctuated substantially in recent years, it tended to decrease through 1965- 2014 period ending at 108 516 metric tons in 2014 (Morojele and Sekoli, 2016).

Lesotho faced severe weather variability for the second year in 2003, characterized by heavy rainfall, frost, hailstorms, and tornadoes (Malebajoa, 2010). The erratic timing of rainfall and frost severely affected crops at planting time and during their critical development stages. Heavy rainfall in October and November delayed or prevented planting of crops in many areas and frost in March curtailed the end of the growing season (Lesotho Review, 2015).

Statement of the problem

The above-mentioned three major cereal crops grown by farmers in Lesotho compete for resources such as land, funding, labour and time. All these resources are subjected to the limitations. As one type of cereal is increased in terms of land planted, the land for other cereal has to be reduced. Similarly, when more funds are used for one cereal crop, funding for the other will has to be reduced. In the same token, where more resources are committed to one cereal, others suffer. This trend has led to fluctuation among the production of major cereal crops from one year to the other.

However, over the years, the trend can show as to which crops are leading in sequence in terms of area, production and productivity. It is of paramount importance to determine if there is a change in the composition and trend among the cereal crops grown in Lesotho. Changing eating habits of the Basotho living in the urban areas also affect cereal production. Most of the urban dwellers have switched from less consumption of maize-meal to high consumption of bread and its by-products as well as rice.

Justification

It is of utmost importance to know the trend in the composition of the cereal crops grown in Lesotho so that effort could be placed on the ones with low production if demand for it is high. Similarly, there is a need to know which direction the change in the composition is taking and if it is deemed necessary to facilitate or redirect it to where it is needed. Consumers eating-habits change with time based on number of factors including among others, cultural change, family house-hold economy, disposable income, politics, education and introduced nutritional programmes. These change in consumer eating habits lead to changes in demand for different cereals, hence a need to monitor them. Prediction about the future of cereal production can be easily performed using the trend which will in turn assist in manipulating variables affecting change in production to our interest.

Specific objective

- To compare the composition of major cereal crops grown in Lesotho in terms of percentage area, production and productivity.
- To establish the trend in production of cereal crop.

MATERIALS AND METHODS

Study area

The study was conducted in cereal crops grown in arable land of Lesotho covering four ecological zones, namely; mountain, foothills, lowlands and Orange River valley. The difference in ecological zone is due to altitude, topography, climatic and edaphic factors.

Data Collection

Given the time constraints, this research was heavily reliant on secondary data. Bureau of statistics in Lesotho, Ministry of Agriculture and Food Security and Department of Agricultural Research furnished secondary information. Data on production, area and yield of maize, sorghum and wheat from 1961 to 2017 obtained.

Data analysis

Data collected were entered in the computer using EXCEL spreadsheet. From these data, Linear and pie charts were drawn, after which trend line, coefficient of determination and regression equations were calculated.

RESULTS

The results revealed that in Lesotho, maize dominated other cereal crops during the period of years 57 years (Figure 1). High production, large area planted and high yield were obtained constituting 61; 65; and 60 percent, respectively. This was due to adoption of high yielding varieties of maize and extension service priority given to maize as it has become the staple crop among Basotho. Sorghum constituted more production, yield and area than wheat respectively, because of its physiological features that enable its cultivation in four agro-ecological zones of Lesotho (Ahmad *et al.* 2015). The highest percentage obtained in sorghum was 22%. Wheat obtained lowest percentage of 17%.

Composition of cereal crops

The three main cereals grown in Lesotho are maize, wheat and sorghum, with maize by far the dominant one accounting for 61% of the country's cereal production. Although maize production has been on the decline in recent years, it remains the country's staple food, constituting an estimated 61% of the rural diet (Food and Agriculture Organization, 2006). This has been observed in 1961 and 2015 with highest production of 110 00 tons and 19,182 tons, respectively. The highest production of sorghum was in 1974 with 84.013 tons and 1978. Sorghum production constituted only 22%; lastly wheat was the lowest with 17%. The highest peak in production was 57.903, 57.552, 58.000 and 59.696 in the following years 1971, 1970, 1966 and 1969, respectively. However, three most important food crops in the world are rice, wheat and maize. Sorghum is considered as minor crop (Awika, 2011; Macauley, 2015). Wheat is the second to rice as the most important source of calories for human (Awika, 2011).

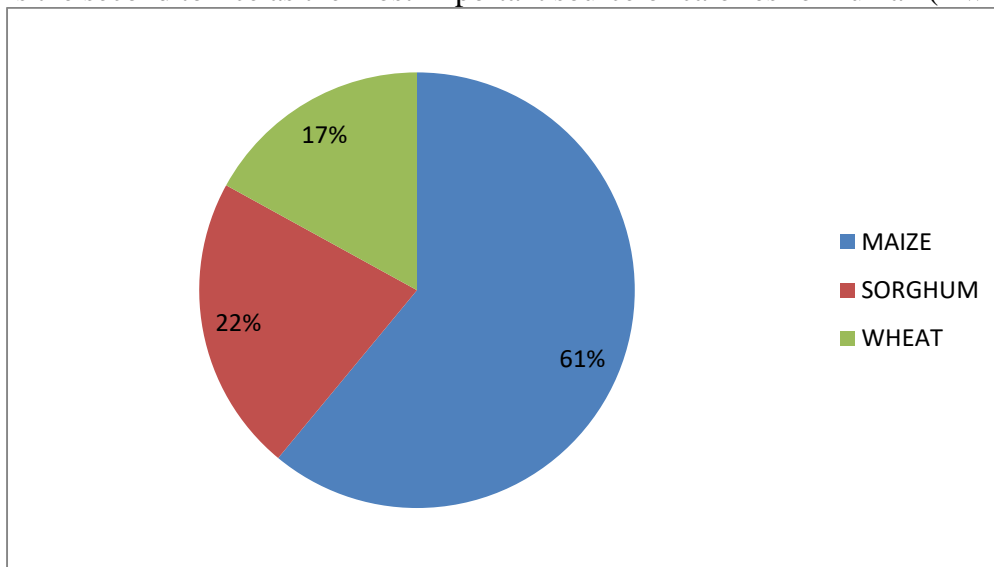


Figure 1. Production composition of major cereal crops

Area composition

The composition of maize in area planted is high with 7243.0955 ha. This percentage showed that maize was allocated large area as compared to sorghum which had 2633.461 ha and the least area planted was in wheat. Most African countries do not allocate large area for wheat. In Lesotho, it constituted area of 1215.565ha from 1961 -2017 (Bureau of statistics, 2014). Area is shown in figure 2 below.

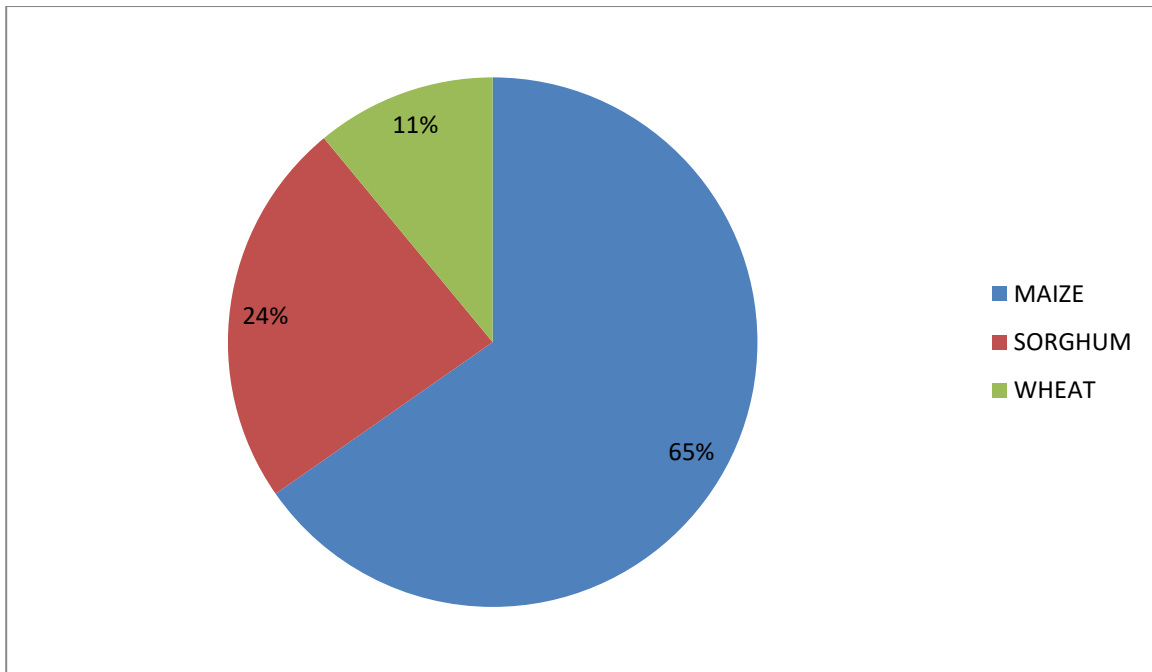


Figure 2. Composition of area planted for major cereal crops

Yield composition

Maize yield constitute high proportion of yield with 60% followed by sorghum recording 34% and wheat with 6%. These percentages show that maize always dominates in area, production and yield. These also happen in the countries of the world where maize had all merits and was followed by wheat not sorghum as it has been observed in the case of Lesotho (Awika, 2010). The yield of sorghum was higher than that of wheat with 34%.

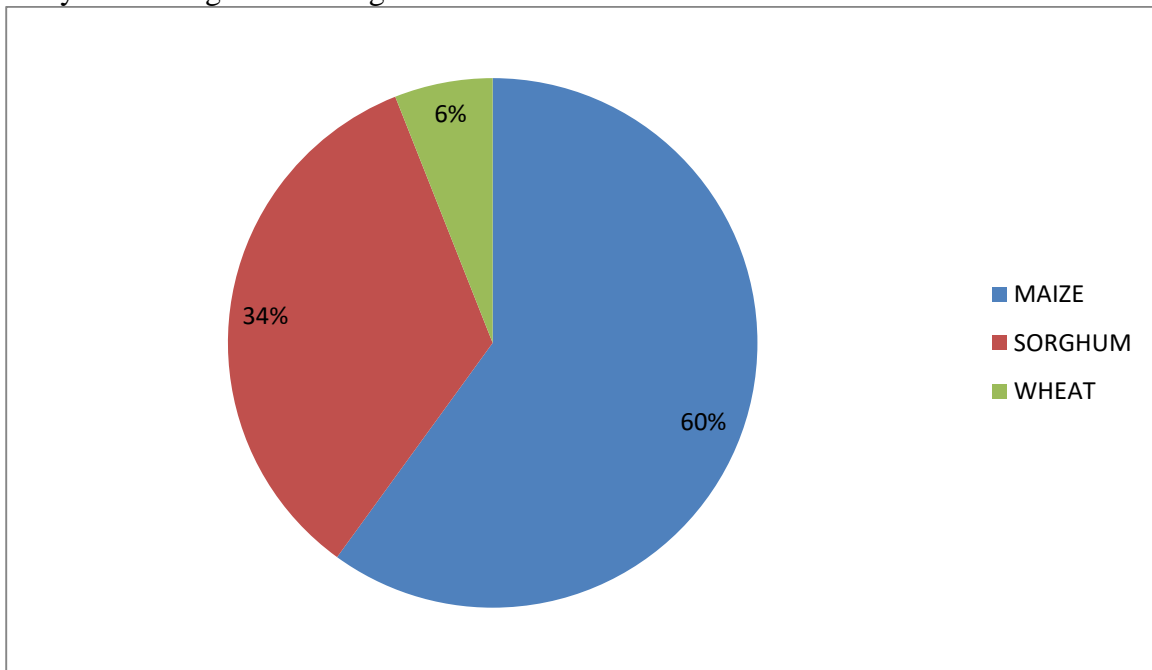


Figure 3. Composition of yield of major cereal crops.

Production analysis of maize, sorghum and wheat

Maize production was the highest of the three major cereal crops grown in Lesotho during the year with 2000, 142 tons in 2016 followed by 188, 489 tons in 1996 and 171,579 tonnes in 1990 with peaks and trough varying in depths and heights within 57 year time period and decline of 12% was observed in 2012 and 2013, from 1961 to 1967 (Morojele and Sekoli, 2016). However, the production level increased from 1964 to 2016. Figure 1 below indicates the production curve and trend line during the period under study. 1979 and 1994 trend line showed a slight decrease in maize, the production line showed the highest peak from 2003 to 2015.

Moreover, sorghum had the highest peak of 85,775 in 1978 and 84,013 in 1974. The production level decreased in 2012 and 2015 due to number of factors such as insect infestation, theft and climate changes, from 1961 to 1964 production level was consistent maintaining the level of 55,000 tons. Trendline shows a decrease from the year 1982 to 2015.

Wheat was the last performer in production level with slide increase in 59,696 in 1969, 58,000 in 1966 and 57, 903 1971. Most troughs were achieved in 2008 where production was 3,72 tons followed by three troughs of 3, 956, 6,085 and 7,900 in 2007, 2006 and 2016, respectively. This was due to poor cropping systems and climate changes with prolonged rainfall. There was a downwards decrease in production trendline of wheat from 2003 to 2015. This was due to severe weather variability in this period of 57 years, characterized by heavy rainfall, frost, hailstorms, and tornadoes (FAO, 2002). Figure 3 indicated the production of three crops.

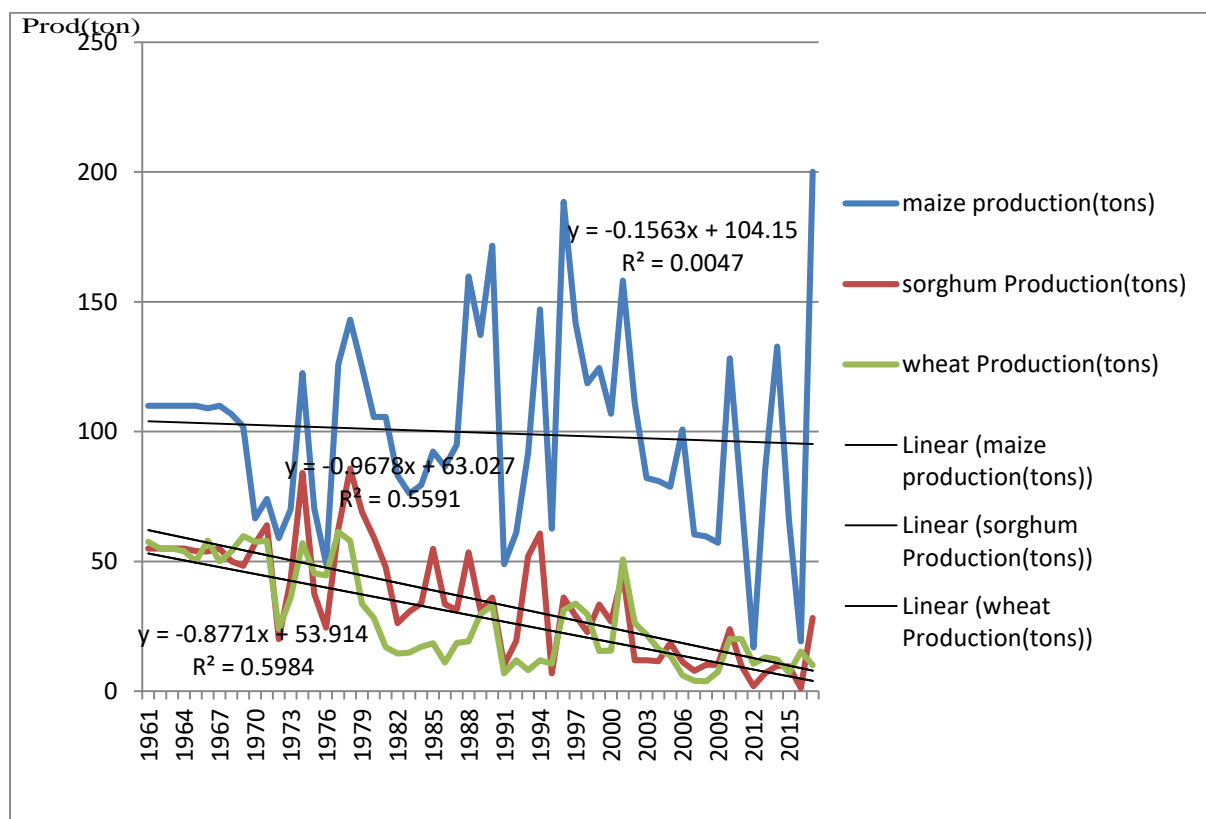


Figure 4. Production trends of maize, sorghum, and wheat

Area analysis of maize, sorghum and wheat

The area planted maize remained unchanged from 1961 to 1964 at 135,000 ha. There were nine peaks and ten troughs of varying levels observed in area planted during 1961 to 2017. In 2001, the largest area of 177,485 ha was planted, followed 173,214 ha in 1988, then 172,743 ha in 1994 and 168,765 ha. The smallest area planted in this 57 year period was 76,955 hectares in 1995, followed by, 73,506 in 2016, then 80,336 hectares in 1977, then 90, 461 hectares, 90, 030 hectares and 97,711 hectares in 1981, 1998 and 2012, respectively. Fluctuations were observed on the trendline.

Trendline showed constant area of 129,247 hectares planted maize over the time period of 57 years from 1961 to 2013. Trendline, was constant throughout these 57 years. The area for sorghum production remained constant in 1961 to 1964 at 65,000 hectares, only three peaks and four troughs were observed in area planted in 1961 to 2017. The largest area planted was 76,355 ha in 1988, followed by 75, 559 in 1987 and smallest area planted was observed in 1995 at 8,579 ha, 2016 at 10,422 ha, 1988 at 15,453ha, 2009 at area of 17,585 ha and lastly 2011 at area of 18, 86 ha. Trendline showed a decrease due to pest and climate change.

Similarly, the trend in area planted to wheat decreased dramatically from 52,400 ha in 1978 to 4,200 ha in 1999, resulting in a decrease of 82%. From the time-period 1962 to 1973, there was a steady decline from 39 119 ha to 36 000 ha, followed by gradual increase to 52,400 ha in 1978, after which gradual reduction was experienced until 1999 where 4,200 ha was planted. The largest area of 52,400 ha was planted in 1978 while the smallest area of 4 200 was planted in 1999. The trendline of wheat showed a significant decrease as head-boy allow animals to graze on planted wheat reducing area planted.

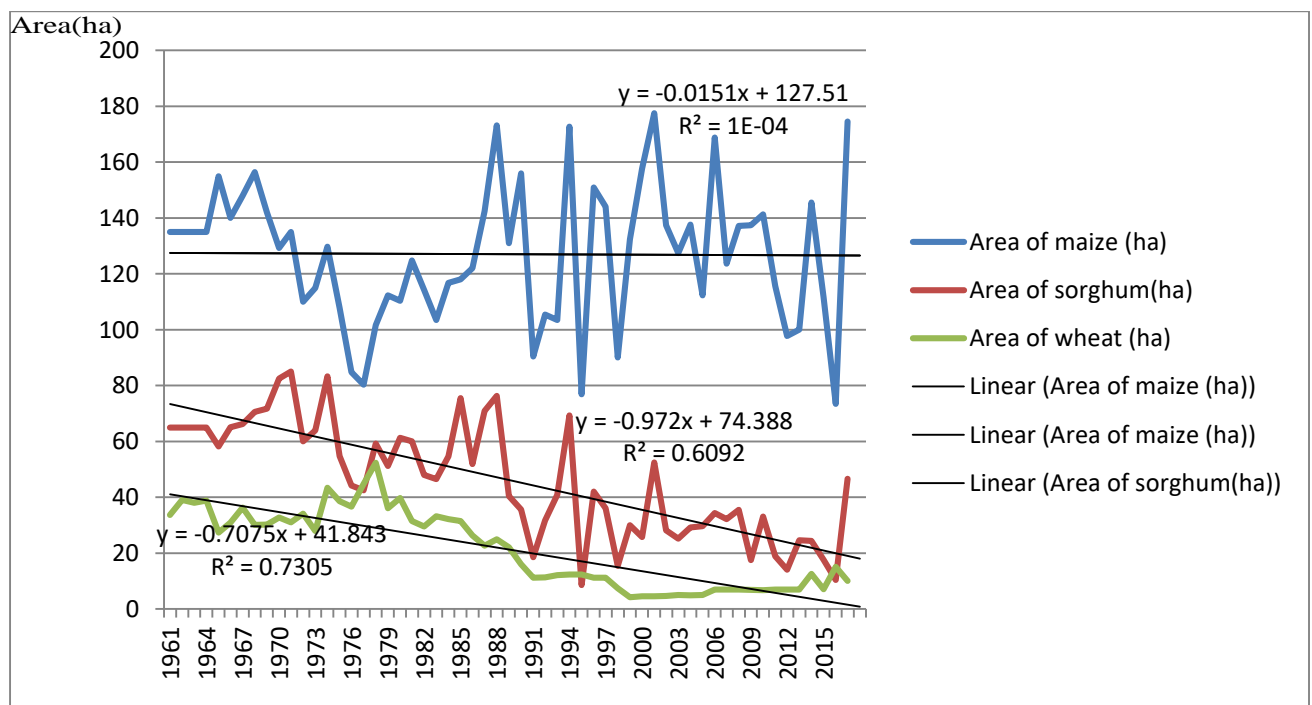


Figure 5. Areas of maize, sorghum and wheat.

Yield analysis of maize, sorghum and wheat

Trendline of maize revealed an infinitesimally small increase in the yield of 814,8 kg ha⁻¹ in 1961 to 860.0 kg ha⁻¹ in 2017 (Figure 3) even though it was higher than that of sorghum and wheat. During this time-period, there were four peaks lying above the trendline. Below the trend line, five troughs were experienced. Highest yield obtained was 1567.6 kg ha⁻¹ in 1977, followed by 1317, 1 kg ha⁻¹ in 1998, 1249.0 kg ha⁻¹ in 1996 and 1100 kg ha⁻¹ in 1990. Below the trendline, three troughs of same yield of approximately 500 kg ha⁻¹ in 1970 to 1972, 1976 and 1991 to 1992 were observed. Lowest yield of 171.8 kg ha⁻¹ and 15.94 kg ha⁻¹ were realized. However, trendline decreased from 1981 to 2017.

Sorghum trend yield shows erratically fluctuation throughout the period of study from 1961 until 2017. 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. There were three peaks from 1977(14.667), 1978(14.469), 1998(14.763) the troughs were only four, 2014, 2016, 2015 and 2017 with 0.40 tons, 0.11 tons per hactar, 0.54 tons per hectar and 0.61. The yield of sorghum comes to be the second after maize with highest peak of 14.763 tons.

Trendline decreased significantly due to natural pathogen such as birds. Wheat was the least with highest peak of 1.96 ton in 2001. Trendline also showed a decrease due the natural hazards, pest and diseases.

The third crop after sorghum was wheat, the yield was fluctuating in 1961 to 1981. The highest peak was obtained in 1969 and 1965 with 11,165 tons ha⁻¹ and 11,105 tons ha⁻¹. There were more throats than peaks in 2015; 2016 and 2017 with average yield of zero. The trendline steadily decreased to negative during the period of study. Shown in figure 5.

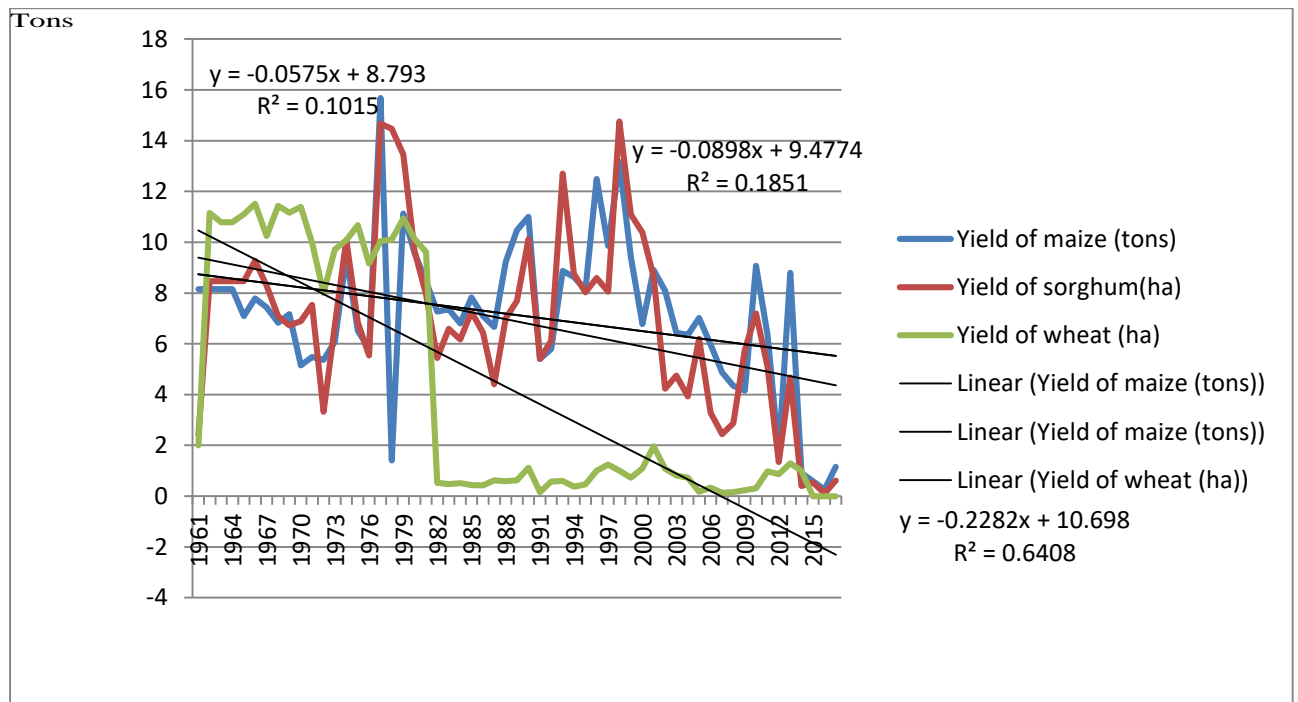


Figure 6. Yield of maize, sorghum and wheat.

DISCUSSION

The average production, area planted and yield were fluctuating, decreasing and increasing within 57 years of the study. Number of factors caused instability in cereal production such poor soil structure, adverse weather conditions and pest. These have caused increase in importation of cereal crops. These fluctuations happened in India and Nigeria where production, area and productivity were fluctuating resulting in high importation of cereal crops (Ahmad *et al*, 2015; Anderson *et al*, 2013).

Analysis of growth in production of cereal crops was done using the estimated regression coefficient of time trend variable as in equation 2. The adjusted R^2 values for maize, sorghum and wheat were 0.004; 0.559 and 0.598 respectively. This showed the goodness of fit between the data and statistical model.

Trend variable accounted for 0.4%; 55.9% and 59.8% in production. The adjusted value of area for three major cereal crops was 1E-04; 0.609 and 0.730, respectively. Trend variable accounted for 40%; 60.9% and 73%. The adjusted R^2 for yield of maize, sorghum and wheat was 0.185; 0.101 and 0.640. Trend variables were 18%; 10.1% and 64% respectively. The country imported more than it could export from 1961 to 2017 (Bureau of statistics, 2014; Bareja, 2015). These also happened in Nigeria where there was steady rise in the imports and decline in export of cereal crops in from 1990 to 2000 (Sanus, 2010; Beyo *et al*, 2013). These indicated that there would be severe hunger in two years time.

CONCLUSION

The results indicated that in Lesotho, there was a slow and positive growth rate for cereal production, area and yield during the period of study in cereal crops. Moreover, area planted for maize was higher in production and yield. Followed by sorghum and then wheat. Therefore, efforts should be made to enhance the productivity of the area under cereals cultivation to achieve higher production through increased use of improved seeds, technology transfer and quality input supply to Lesotho in order to reduce food insecurity as well as poverty problems.

RECOMMENDATIONS

It is recommended that the factors affecting the cereal production be further researched and ranked according to their perceptible influence. Those with less influence be manipulated to increase production, particularly artificial ones like soil moisture deficit that can be supplemented by irrigation, poor soil fertility by fertilizer, weeding by herbicides and others. Natural factors affecting production can be mitigated by adjustments, prediction and introduction of new technology.

References

- Acquah B. M. (2015). Principles and techniques of crop production. Blackwell: London.
- Ahmad, Q., Muhammad H. S. N., Muhammad .F. S., Muhammad. S., and Safia M. (2013). *Journal of Cereals and Oilseed, The importance of cereals (Poaceae: Gramineae) nutrition in human health: A review*. Vol. 4(3), pp. 32-35.

- Abeyo,B., , Shiferaw ,B., Koo,J.,Sonder,K.,Smale,M., Braun, H.J.,Gegbele, G.Z., Hodson,D.,Negassa,A., and Wood,S., Payne,T.,(2013) . The Potential For Wheat Production in Africa: *Analysis of Biophysical Suitability And Economic Profitability*.4:20-25.
- Ahmad, M. I., Makama, S.A and Kiresur, V.R., Samuel, E., (2015).Trend of area, Production and Productivity of major cereals: India and Nigeria Scenario. *Research Journal of Agriculture and Forestry Sciences*. 3:10-15.
- Anderson,D., T, and Borsen, B., W.(2013). Oklahoma cooperative extension service. *The world's wheat supply*.4:1-10.
- Awika, J., M. (2011). Major Cereal Grains Production and Use around the World *Soil & Crop Science Dept. /Nutrition and Food Science Dept*.7:2-11.
- Bareja, B, G. (2015).What are cereal crops and pseudo cereals.*Journal of cereal production*. 5:3-5.
- Bureau of statistics. (2014). Lesotho Agricultural situation Report. *Ministry of Economics of planning*, Maseru .4:1-9.
- Dyke, M, A. (2019). *Comparative Experiments with field crops*. London: Butterworth and Co. Ltd.
- FAO. (2016) Food and Agriculture Organization of the United Nations. *Food Outlook*. 3: 9-10.
- FAO. (2012). Assessment of 2005/06 Agricultural Production in Lesotho. *Support To the Agricultural Season Assessment Lesotho*.5:8-15.
- FAO. (2006) Food and Agriculture Organization of the United Nations. *Food Outlook*. 3: 9-10.
- FAO, (2002). FAO/WFP. *Crop and Food Supply Assessment Mission to Lesotho*.7:9-15.
- Gallagher, E. J. (2014). Cereal production. London: Butterworth .Co. Ltd.
- Grundy, T. B. 2018. Cereal production in temperate region. Butherworth: London.
- Gwitz, M. 2014. Utilization of cereals for industrial products. *Field Research*. 9:41-48.
- Lesotho Review. (2015). *Climate of Lesotho* [Http://www.lesnet.org.ls/climateology/Climate Lesotho](http://www.lesnet.org.ls/climateology/Climate%20Lesotho).
- Macauley, H. (2015), Feeding Africa. *Cereal crops: Rice, Maize, Millet Sorghum, Wheat*.2: 20-27.
- Morojele and Sekoli (2016). Global Journal of Agriculture Research. *Sorghum productivity trends and growth rate for Lesotho*.4:52-57.
- Muyambo, F. (2018). *Cereal grains of African*. London.
- Orr A, Mwema C., Gierend, A., and Nedumaran, S. (2016).Sorghum and Millets In Eastern and Southern Africa. *Facts, Trends and Outlook*. 3: 62-76.
- Malebajoa, A, M, 2010.Climate changes impacts on crop yields and adaptive Measures for agricultural sector in the lowlands of Lesotho. *Climate*. 4: 12-7.
- Sarwar, Sarwar, Qadri and Moghal, 2013.The importance of Cereals (Poaceae:Gramineae) nutrition in human health: A review. *Journal of Cereals and Oilseeds*.9:31-37.
- Sanus, J.(2010). Principle of Crop Production. Victoria Island, Lagos.
- Suresh, S. S., Mark, F. M. and Steven, P. 2019. Production and utilization of cereal crops in the tropics. *Field Crop Research*. 3:34 – 44.
- Williams, D. E. 2015. Cereal Production. London: Blackwell.