Sorghum Forage Farming for Crisis Resolution and Food Security in a Changing World: A Preliminary Study of Taraba State Nigeria Sorghum Production, Prospects and Problems

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Authors’ contributions

This work was carried out in collaboration among all authors. Author ATG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MBY and BEB managed the analyses of the study. Author YGC managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

Taraba State is endowed with natural resources; vast lands, water resources, animal resources and human resources. However, amidst plenty, food insecurity and incessant crisis ravage the government efforts to sustainable agricultural and economic development. This paper discusses the nexus between Climate vagaries and skirmish leading to shift in crop yields. It assesses grain yield variation, problems and prospect across the local governments in Taraba State. Apart from personal observation and focus group discussion, the paper relied mainly on secondary data that were generated through the analysis of relevant data from government and non-governmental agencies. Rainfall and agronomic data were collected from Upper Benue River Basin and Ministry of Taraba Agricultural Development Program (TADP) respectively. These were collated and analyzed using standardized anomaly index and linear regression in SPSS environment. The study fails to reject the null hypotheses that no relationship exists between the average annual rainfall...
and quantity of sorghum produced annually. It recommends application of biotechnology using (Sorghum bicolor L. Moench) for animal feeds and food crop diversification to cushion the ever increasing demand for forage that often vortex crisis in the state. SFF can stand heavy grazing reduce roaming encourage ranching eliminate crisis.

Keywords: Forage sorghum; food security; crisis resolution; climate change; Taraba State.

1. INTRODUCTION

More than two decades now the world had been directly or indirectly weighed down by the Climate Change that obviously threatens global food production and potentially exacerbates food insecurity in every parts of the world. Now a more than climate change is here. Effect of COVID-19 on global food security is yet undefined and quantified. One thing is certain, the dual impulse of the two on the economy of developing nations especially poor countries will leave much to be desired. Government efforts to cushion effect of climate change on national economy and human livelihood manifested in the implementation of various policies in many parts of the world and Nigeria is not left behind. Operation Feed the Nation, Green Revolution Programme, Fadama Irrigation Development Projects, Agricultural Development Projects and the Ten-year National Ranch Development Plan. All these programs and policies are targeted by various level of government to fight crisis and food insecurity. Food security is a complex issue comprising the number of people to be fed, soil and climate conditions, the pursuit of healthy rather than traditional feeding pattern, storage, preparation, as well as the proper use of adequate types and amount of food, comprehensive and focused planning and implementation, general knowledge about food composition [1].

Despite that the bulk of Sorghum production is cultivated mainly in the northern states; Bauchi, Borno, Zamfara,Yobe, Gombe, Adamawa, Kaduna, Jigawa, Niger, Kebbi, Nasarawa, Plateau, Sokoto, Katsina, and Taraba, not many works done on the crop from these region [2, 3,4,5]. In fact, studies on sorghum or on fundamentals of sorghum- climate relationship at the local level in the study area are few. Perhaps due to data limitation or close substitutes the crop has. The only documented research in respect of the cereal comes from [6] who investigated the effects of marketing costs on the gross margin of guinea corn retailers in Wukari, Taraba State, Nigeria. The author found out that retailers’ selling price, transport cost, storage and cost due to perishability have significant effects on retailers’ gross margin, at 8, 5, 10 and 9% levels, respectively.

Barnabas et al. [7] affirmed the necessity of promotion of studies which would combine long-term period and multiple locations (spatiotemporal analysis) under variable rainfall and soils to clarify sorghum varieties’ performance. Studies on Climate change models with high resolutions using crop pattern, crop productivities using climate, water and yield models have shown way forward for future projection [8] and when properly harnessed could be palliative in the context of food insecurity. Increased rainfall variability across seasons has resulted to large yield variability and thus becoming an apparent determinant on the performance and adaptation of sorghum varieties [9]. According to [10] in southern Somalia, there was a large unexploited variability in sorghum genetics in relationship to plant type, grain type, adaptability and yield capacity. They added that, Sorghum’s genetic potential has been overlooked and it was far less developed than that of other major crops. But as climate change things are changing. The known breadbaskets, rice lands and corn belts, that were suitable for the more popular cereals became more suitable for sorghum production in the area. The gain from sorghum grains farmstead on the same farm belts far outweighs others.

Understanding the crescendos of food production is critical to improving food security. This is particularly important in regions that rely on subsistence agriculture with little adaptive capacity to climate change [11]. Food security is not limited to provision of man’s meal; it cascades down to the animal’s need that is on the umbrella of food chain of sustainable food security. There are many governments that consciously factor forage for animal needs in their annual food budget. For instance, China is the eighth global producer of sorghum. 30% of her production goes for human food, while 70% are package for animal feed and alcoholic beverages [12]. Sorghum plays an important role in food security in developing countries and most
especially poorest parts of the world. Its genetic potential has been overlooked and is far less developed than that of other major crops [10]. *Sorghum bicolor* (L.) Moench is used for both grain and forage. While some varieties are grown solely for grain, others have been developed for extensive forage production, and some varieties are dual-purpose [13]. Cultivars on the continent could range into the thousands [10]. Varieties are chosen to meet specific uses. Since natural grasses are fast retreating as a result of climate variability, change selections that bridge the food gap is expedient in large scale in the state.

In this parts of the country where grass for forage is becoming gold, and the absence of it when needed can maelstrom crisis, commercial hybrid fodder sorghums, that retain the multi-cut qualities of Sudan grass and have a much higher yield potential would be appropriate [14,15]. They are becoming popular for green fodder in some developing countries and seeds are internationally available [11]. Nigeria has been self-sufficient in the past, but recently, sorghum imports from the United States have been necessary to meet local demand in the northeastern areas because of conflict [16]. The Underutilization of available resources due to lack of information or application of technology can maelstrom conflict where none supposed to be [17] and maintains that most conflicts in Nigeria are premised on land space and resource competition; disputed jurisdiction of traditional rulers; creation and location of local government council headquarters; limited political and economic resources; micro and macro social structures of Nigeria; population growth; and disregard for cultural symbols. In the study area, [18] listed by category, causes and nature of conflicts in Taraba from the onset of the creation of the state to the year 2013. According to them the skirmish is ethno-religious based. It is ethno-religious conflict partly because of the people tendency to spill over from their initial ancestral territory into other localities, states, or even regions of the federation. Also perhaps due to the people’s heterogeneity and multi-religious nature this cannot be easily waived off. However, in the last decade cause of dispute in the study area from documentation Taraba Television Authority (TTV) and Taraba State Broadcasting Station (TSBS), researcher and observers, premised on land space and resource competition. [19] highlighted predisposing factors responsible for fueling conflicts between farmers and pastoralists in North-east. These range from the influx of foreign pastoralists from other countries within the Sahel due to deteriorating conditions of pasture arising from the consequences of desertification, land degradation, unstable rainfall and other climatic factors which compelled some of them to abandon their respective traditional ecological range in the Sahel to most parts of Northern Nigeria [20]. Also when forage fail in quantity for animal needs cattle stray into cropped land under the guide of immature “herdsboy”. Who claimed he has been cultured along the ways of raising, nourishing, and managing the family flock. At many instances such singular mistake had led to many dead in the study area.

In the study area glaringly, eventual decrease in the quality and quantity of pasture leads to increase competition over access to land, water, and grasses between farmers and pastoralists consequently resulting into crisis over right and access to those limited resources. As at the time of compilation of this work, TSBS has just confirmed 8 feared dead and houses and properties worth millions of naira burnt including the house of a minister Emmanuel Bacha in Mararaba ward in Donga Local Government. It is obvious that the carrying capacity of the limited land resources is exceeded as the population increased more so after the North-east insurgency.

The existence of the crisis is not the issue, but the rise and the transformation of the skirmish from its traditional ebb to a modern warfare where the bandits now use dangerous small arms and light weapons is now mindboggling. This has brought about loss of lives and properties as well as threats to the nation and food security. Locally-focused studies are needed for actionable planning purposes that create mechanism for peace and food security. Considering the facts related to better and harmonious farming pattern between herdsman and farmers, the present research discuss the place of forage sorghum in crisis resolution and food security in Taraba. The paper seeks to assess sorghum production, prospects and problems in Taraba State. This study makes an important addition to the literature on the place of forage sorghum in combating food insecurity, hostility check and crisis’ control. It buttresses the role of Sorghum forage farming (SFF) in a quest to initiate longer-term efforts to reform livestock management practices in the country. The outcomes of this work can be used by those stakeholders involved in policy-making for the food and agricultural sector. The information can
also serve as feedback for evidence-based policy discourse at the regional level.

2. MATERIALS AND METHODS

2.1 Study Area

The study area is characterized by tropical continental climate marked by dry and rainy seasons. Dry seasons last for a minimum of five months (November-March) while the wet seasons spans from April to October. Rainfall usually starts around April-May and ends around September-October. Heavy thunder storms occur in major parts of the catchments around July and August, with attendant peak of rainfall at this period, causing major floods and inundation especially in the lower catchments. Mean annual rainfall is less than 1000 mm in latitude 9° [21] and 1350 mm recorded in the Southern part of the State. The rainfall distribution pattern in the study area shows a decrease from the south to the northern part.

The study area falls under the Guinea savanna belt. Generally the trees and grasses are very green during the raining season. The trees shed their leaves in the dry season while the grasses turn brown and are burnt. This marked the beginning of the Nomads migration in most parts of the country and the inward movement when the trees and grasses blossom again. The northern part of the study area is branded by wooded savanna. The wooded savanna vegetation type characterized by short grasses interspersed with short trees is found all over the region; however, intense cultivation, overgrazing and bush burning by local people have depleted the grass cover over large tracts. The vegetation type of the study area has been adversely affected by human activities leading to the clear-cutting of trees over in many parts of the area. Artificial vegetation and few economic trees has replaced natural vegetation especially as we transverse the northern part of the study area.

Information on the soil of the study area based on the textural composition from 0-30 cm depth, using the harmonized world soil, depicts nine different soil types. Among these are NumicNitosols, Lithosols, Fluvisols, Ferric Acrisols, Ferric Luvisolsand Vertisols. From the digital map, more than half of the study area support Ferric Luvisolsand Vertisols. Ferric Luvisolsand Vertisols on which this crop is grown have an agroecological potential for food production above their present level of use [22]. They have high water holding and cation exchange capacities. These types of soil are found on alluvial and fluvo-marine deposits of variable texture, notably along the river flood plain [23]. This vertisols have deeper, better developed profiles, a higher natural fertility and greater water retention during dry season [24]. The soil moisture regime, which is very important in agricultural productivity and of course, water availability, correlates with the incidence of rainfall in different parts of the region [25]. These soils are very suitable for the cultivation of many types of crops. The soil has sandy, loamy and clay features which favors the cultivation of crops such as rice, yam, sugarcane, maize, guinea corn, millet, sorghum etc. Soils with clay-loam or loam texture, having good water retention capacity are best suited for sorghum cultivation [11].

2.2 METHODS

Secondary (quantitative) sources of data were collected and analyzed. Monthly precipitation data was used to generate annual time series for investigating temporal changes in rainfall. Monthly rainfall data was collected from the meteorological stations in the state for 20 years (1999-2019). This was obtained from the Upper Benue River Basin Development Authority (UBRBDA) Meteorological station Head office at Yola which records rainfall in the study area. An equivalent period of observation for sorghum yield was also sought for at Taraba Agricultural Development Program (TADP). The sorghum data were synthesis of the work from two Agricultural Ministries. The yields from 1999-2009 were agricultural production survey by National Food Resources Agency of the Federal Ministry of Agriculture (NFRA). Report on Sorghum by Agricultural Performance Survey of 2010-2019 by National Agricultural Extension and Research Liaison Service (NAERLS). The collected data were collated and analyzed quantitatively using statistical software packages such as 2010 Microsoft excel for linear trend analysis, averages and the Pearson Product moment Correlation Coefficient to establish the relationship between variations in sorghum yield and changes in annual rainfall using one of the driest region: Lau. The correlation coefficient and regression analysis were statistically tested at 95% level of significant with a threshold probability of 0.05 for the sorghum considered. Standardized anomaly index was used to analyze the variability in the rainfall pattern from 1999 – 2019 and to examine the trends in rainfall
distribution of the study area. The formula for the standard anomaly index is given as:

$$SAI = \frac{x - \mu}{\sigma} \quad (1)$$

Where:

$$\mu = \text{mean} x = \text{Annual rainfalls} \quad \text{standard deviation}.$$  

Linear regression was used to examine the relationship between rainfall variability and sorghum yield.

The formula for the linear regression was given as:

$$y = a + bx \quad (2)$$

Where:

$$a = ya - bxa \quad \text{and} \quad b = \frac{N\Sigma xy - \Sigma x \Sigma y}{N\Sigma x^2 - \Sigma x^2}$$

$y =$ sorghum (Metric tons) \quad $x =$ rainfall (mm). The results of these analyses were presented in tables and figures.

3. RESULTS AND DISCUSSION

This section discussed the result from the climatic and agronomic data analyzed.

3.1 Prospects Despite Seemly Problem of Food Insecurity

3.1.1 Regional contribution to sorghum production in the state between the years 1999 to 2019

In Taraba, the problems of food challenges have affinity to poverty level, hike of food stuff, hostility and conflict, joblessness; increase theft and kidnapping and not outright climate change. This climate induced- challenges affect individual farmers and put the household food security status at risk. This result corroborates the finding in Buea except that climate change tops the list of the causative agent [26].

Suffice to say that despite the identified setbacks, as well as the climate vagaries, food security within the Taraba State is guaranteed. The reason is not far-fetched. This is related to the high diversification of crops cultivated by farmers. The 16 Local Government soil and environment support cultivation of all types of food and tree crops. Fig. 1 Shows the Sorghum Production in Taraba.

Except Gembu, Sorghum is grown in all the 16 local Governments of Taraba. There is no significant variation in yields among the Local governments. Considering the local outputs of sorghum from the various LGA, Gassol has the highest yield with mean production of (29 Metric tons/year) between 1999 to 2019 while the least yield for the period considered was from Zing with mean production of (3.9 Metric tons/year). There is more from the central Taraba (88.1 Metric tons/year) to the State Gross Product (193.7 Metric tons/year) than North (60.6 Metric tons/year) or Southern Taraba (42.4 Metric tons/year).

On average look, the trend of sorghum production depicts an incremental yield of 16 Metric tons annually. From 2004 there is sharp and continuous increase in production of the crop in the study area until it picked in 2014. This increase may not be unconnected to the relative peace experienced in the state during the formal administration of His Excellency, Pharmacy Danbaba Danfulani Suntai. Farmers are at ease at their farms. In fact Taraba became the city of refuge to IDPs from neighboring states as the governor himself oversees to the security of the state using air combat. The influx from the warring zones added more hands to farming business at the various communities.

An obvious drop from 2015 till date is worrisome. 2016 correspond to the period where the conflict becomes unbearable. [27] submitted that violent conflicts between nomadic herders from northern Nigeria and sedentary agrarian communities in the central and southern zones have escalated in recent years and are spreading southward, threatening the country’s security and stability. They added that, from onset of the crisis till 2016, estimated death tolls of approximately 2,500 people have been recorded. They confirmed that the clashes are becoming as potentially dangerous as the Boko Haram insurgency in the north east. This scenario seems changing the distribution of agricultural land use. Obvious now is farmers’ withdrawer from the farmlands to intensive hinterland farming close to houses and drains. Growing a smaller tonnage of a given crop on each unit area expectedly brings lower output. Competition of two crops in the same area depends on their relative profitability and yield. This reduction in production from 2016 probably could have a link also to the increasing
Fig. 1. Regional contribution to sorghum production 1999-2019
Sources: Computed from the available data from archives of (NFRA and NAERLS)

Fig. 2. Trend of sorghum yield in the state
Sources: Computed from the available data from archives of (NFRA and NAERLS)
Table 1. State percentage contribution to national mean produce of sorghum (1999-2019)

<table>
<thead>
<tr>
<th>Years</th>
<th>SPPA (Metric tons)</th>
<th>NAMP (Metric tons)</th>
<th>SPCNAMP (Metric tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>44.75</td>
<td>385.3</td>
<td>11.6</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
<td>334.9</td>
<td>11.9</td>
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<tr>
<td>2001</td>
<td>41</td>
<td>320.1</td>
<td>12.8</td>
</tr>
<tr>
<td>2002</td>
<td>41</td>
<td>309.9</td>
<td>13.2</td>
</tr>
<tr>
<td>2003</td>
<td>48.5</td>
<td>308.4</td>
<td>15.7</td>
</tr>
<tr>
<td>2004</td>
<td>174.8</td>
<td>310.5</td>
<td>56.3</td>
</tr>
<tr>
<td>2005</td>
<td>185.6</td>
<td>336.0</td>
<td>55.2</td>
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<tr>
<td>2006</td>
<td>198.8</td>
<td>350.1</td>
<td>56.8</td>
</tr>
<tr>
<td>2007</td>
<td>170.4</td>
<td>363.9</td>
<td>46.8</td>
</tr>
<tr>
<td>2008</td>
<td>178.9</td>
<td>378.1</td>
<td>47.3</td>
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<tr>
<td>2009</td>
<td>187.9</td>
<td>400.1</td>
<td>47.0</td>
</tr>
<tr>
<td>2010</td>
<td>198</td>
<td>506.7</td>
<td>39.1</td>
</tr>
<tr>
<td>2011</td>
<td>190.9</td>
<td>459.8</td>
<td>41.5</td>
</tr>
<tr>
<td>2012</td>
<td>187.4</td>
<td>359.0</td>
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<td>72.3</td>
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<tr>
<td>2017</td>
<td>325.7</td>
<td>450.6</td>
<td>72.3</td>
</tr>
<tr>
<td>2018</td>
<td>342.5</td>
<td>448.1</td>
<td>76.4</td>
</tr>
<tr>
<td>2019</td>
<td>267.6</td>
<td>406.0</td>
<td>65.9</td>
</tr>
</tbody>
</table>

SPPA; State Produce per Annum; NAMP: National Annual Mean Produce; SPCNAMP: State Percentage Contribution to National Annual Mean Produce.

Sources: Computed from the available data from archives of (NFRA and NAERLS)

local prices as well as growing demand for maize in the area. Maize is a close substitute to sorghum and the price of maize of recent has continued to soar in the state. These encouraged farmers to extend the planted area for corn in the region, hence penalizing the sorghum production. Non-food demand such as school fee of wards, house rents and other indispensables make farmers to grow crops that attract better pay. Major use to which the cereal is put is in the area of local brew of alcohol generally known as burukutu.

3.2 Climatic Impacts on Sorghum Yields

This section discusses intra-annual variability of rainfall and stability in Sorghum yield in one of the driest region of the state.

The variation in the sorghum output in the region may not be out-rightly linked to the role of climatic parameter. Pilot test of state of relationship choosing one of the driest Local government areas; Lau revealed that rainfall pattern for the period considered varied between the years. The total annual rainfall rose from 622.4.2 mm in 2003 to 1286.3 mm by 2012. Of all the years rain distribution for 2003 was the lowest, 2012 had the highest rainfall. The mean of the rainfall for the period under consideration is 872.2mm. Sorghum is often grown in regions that get between 350–700mm of precipitation annually [28]. The result of the standardice anomaly index (SAI) indicates that from 1999 to 2011, almost a decade and half, rainfall has been below normal except in 2005. For the years under consideration, dry years triple the wet years. This variation of the rainfall over the region showed that in the more recent years, lower annual rainfall was received compared to the earlier years implying that the region is becoming drier. This rainfall variability in the study area has not only been between years, but also within years. This may have implication on agricultural production. According to [29], the amount and distribution of rainfall in a given year determines the success or failure of crop production. Assurance of optimum rainfall will promote optimum yields. Climate change is a threat, mostly to countries that rely on rain-fed farming and lack adequate adaptive capacity. This lag can be worsening with localized factors such as culture and even conflict. These facts cannot be ignored when considering strategies to improve production.

Future research on seed improvements using biotechnology should incorporate climatic impacts on Sorghum pests and diseases. In Buea, according to [26] variability in climatic
parameters especially temperatures do not only affect the anatomical and physiological welfare of the cereal plant, they equally observed to have indirect effects on maize especially through pests and diseases.

Deliberate choosing of the driest region was done for this pilot test. Based on this analysis, it is clear that climatic effect on sorghum production arising from continuous warming and decrease in rainfall amounts observed as of now seems not a qualm in sorghum production in the region. There exist inverse relationship and insignificant relationship between sorghum yield and rainfall variability ($r = -0.02$). This implies that a decrease in rainfall, may not warrant a decrease in yield. Test of the effect of rainfall factor for rainfall significant value 0.497 (> 0.05). It means there is no evidence to suggest good agreement in relationship between the rainfall and sorghum yield ($p = 0.497$). $H_0$ is accepted which mean there is no significant relationship between rainfall and sorghum production in the area (Table 2).

The regression reported an $R$ squared of 0.000. This means that total annual rainfall (the independent variable) account for practically nothing in the annual quantity of sorghum produced over the period. Indirectly 100% of the variations in the quantity of sorghum produced annually cannot be explained or accounted for by the total annual rainfall. These variations are caused by other factors that affect production, which are exogenous to the model (for example, use of improved seeds, fertilizer application, soil type, etc.) that could have various effects on the output of annual production per hectare. The constant intercept is indicative of the fact that, the annual quantity of sorghum produced will be 13.542 metric tons per hectare if the average annual rainfall was 0 mm. The slope of the line 3.143E-5 also shows that an increase in the average annual rainfall by 1mm will increase the annual quantity of sorghum produced by just 0.00003143 metric tons per hectare. Thus, there is a slight positive relationship between average annual rainfall and the annual quantity of sorghum produced. From the analysis, it can be concluded that rainfall does not affect the sorghum crop production. Thus, sorghum plantation can be focused on land that cannot be planted with rice, either permanently or temporarily.

3.3 Sorghum Forage Farming For Crisis Resolution

Crop simulation models indicate that by 2050 in Sub-Saharan Africa, average rice, wheat, and maize yields will decline by up to 15, 22, and 10%, respectively, as a result of climate change [10]. This understanding had made countries like China and some other developed nations to start harnessing sorghum crop. This crop can also be used to improve livestock management practices to minimize friction with agrarian communities. According to [11] in an environments where water is limited due to drought or declining aquifers, and where it is necessary to conserve or reallocate available water, forage sorghums

![Fig. 3. Intra-annual variability of rainfall in Lau one of the driest region of the state](Source: UBRBDA, 2019)
Table 2. Regression for the relationship between sorghum yield and annual rainfall in Lau

<table>
<thead>
<tr>
<th>Correlations(^a)</th>
<th>Sorghum yield in Lau</th>
<th>Rainfall total in Lau</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1.000</td>
<td>-.002</td>
</tr>
<tr>
<td>Rainfall Total in Lau</td>
<td>-.002</td>
<td>1.000</td>
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<tr>
<td>Sig. (1-tailed)</td>
<td>.002</td>
<td>.497</td>
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<tr>
<td>N</td>
<td>.497</td>
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<tr>
<th>Model summary(^b)</th>
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<tbody>
<tr>
<td>Model</td>
<td>R</td>
<td>R Square</td>
</tr>
<tr>
<td></td>
<td>R square change</td>
<td>F Change</td>
</tr>
<tr>
<td>1</td>
<td>.002(^a)</td>
<td>.000</td>
</tr>
</tbody>
</table>

\(^a\) Predictors: (Constant), Rainfall Total in Lau
\(^b\) Dependent Variable: Sorghum Yield in Lau

<table>
<thead>
<tr>
<th>Coefficients(^c)</th>
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<tr>
<td>Model</td>
<td>Unstandardized</td>
<td>Standardized</td>
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<tr>
<td></td>
<td>coefficients</td>
<td>coefficients</td>
</tr>
<tr>
<td>Rainfall Total in Lau</td>
<td>-3.143E-5</td>
<td>.005</td>
</tr>
</tbody>
</table>

\(^c\) Dependent Variable: Sorghum Yields in Lau
are promoted as a substitute for more water-consum ing crops, particularly maize. Sorghums will be exceptionally valuable forage wherever water becomes a scarce and precious resource due to global climate change [30]. This implies that all vast land deemed unfit for other cereals sorghum can manage for fruitfulness. Erosion ravaged sites can be procured for regeneration with the use of SFF. In Queensland, Australia, sweet sorghum was one of the species successfully used in attempts to re-vegetate severely degraded bluegrass pastures (Dichanthium sericeum). It was added to the mixture to give extra competition to volunteer weeds, and as a safety measure to ensure cattle had fodder in the paddock [31]. It is used by commercial farms in the USA where it is considered to offer better control of weight gain in growing cattle [32]. The sorghum silage was more palatable than maize silage (+ 15% DM intake), milk production was similar (about 20 kg/d) and fat content was higher with the sorghum treatment (4.26 vs. 4.01%) [33]. This means herdsman can acquire and grow large area for commercial purpose and to feed their cattle. With the current situation of farming and as greater attention is being given to environment issues, sorghum is a crop with advantages offering genuine value. Since natural grasses are fast retreating as a result of climate change selection that bridge the food gap is expedient in large scale. Nevertheless, at farmers’ level, potential productivity and financial edges act as guiding principles and level of operation. At micro-level, some forces influence level of productivity and that is where the government at all tiers come in. The farming pattern and combination which involve rearing of cattle and growing of feed and fodder hinged on availability of infrastructure facilities, socio-economic factors and technological developments, all functioning interactively at micro-level. In a research carried out among the Fulbe nomads in Adamawa and Taraba states [34]. A total of 114 nomadic homesteads were studied from five distinct locations: Song, Numan, Mayo-Belwa, Zing and Jalingo area. The question as to what must be done for them to settle down for business jettisons itinerary and buoy ranching. 78.1% listed dams, grazing reserve, veterinary services, good sanitation facilities, market space. 53% insisted only on water and pasture. The government’s order by Federal Ministry of Agriculture and Rural Development (FMARD) in 2015 to import fast growing grass from Brazil to produce a massive hectare of grass is a welcome idea though this has not been implemented. However, SFF is a better option because grass farming has implication but SFF is a two edged sword. This can fight hunger and crisis.

4. CONCLUSION

Low crop production increases food insecurity and can vortex crisis. Improved agricultural inputs can help counteract the effects of land and resource scarcity and reduce the impact of this factor. Forage sorghum has been boosted by recent innovations offering significant prospects for progress. Garnishing grazing reserves and livestock routes with Sorghum Forage will not only create job opportunity but address food insecurity in the state. For sorghum to attain a more prominent status, and to fully tap the potential of increase productivity and farm income, the study surmises that expanded access to improved technologies on sorghum production should be extended to the farmers through extension services. There is ongoing and dynamic development of new varieties, with genetic advances improving features such as earliness, productivity, feeding value and adaptation to limited water resources. This opportunity can be harnessed to solve the problem of food insecurity and address farmers and pastoral skirmish.

The state can do better than subsistence farming. Effort should be geared towards full scale production of sorghum in all the Local Governments. Sorghum is likely to adapt to different rainfall conditions in the state. From the analysis, it can be concluded that rainfall does not affect the sorghum crop production. Reduce rainfall is not a limiting factor for sorghum production in the State. The government quest to initiate longer-term efforts to reform livestock management practices in the country, SFF is the key. Full fledge SFF can create employment for youth and improve livelihood. SFF can stand heavy grazing reduce roaming encourage ranching eliminate crisis.

5. RECOMMENDATION

Apart from the 7 points bold step earmarked by [19], pertinent to demotion of conflict and sustenance of peace building in the north eastern Nigeria, the use of biotechnology for crop production is long overdue. There have been impressive successes with respect to improving yields through biotechnology in many developed countries. Government of Nigeria could take a
cue. The resource (land) is fixed and population and poverty soar, Nigeria government should be proactive in management of resources (Human and Natural). Nomad roaming may be replaced by ranching with aid from biotechnology advancement. Where we have grazing lands and routes, laws governing the operation and use should be respected by farmers and pastoralists. Ranching could go well with extensive forage sorghum farming. Full-fledged operation of SFF on dry lands, grazing reserves, livestock routes, erosion ravaged areas, or paddy fields during the dry season should be encouraged and sustained by all tiers of governments. Empowerment through pluralistic approach like this will not only improve livelihood but curb crisis when properly harnessed. So soil suitability mapping of the study area will not be out of place for the takeoff of the project.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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