Sustainability and Challenges of Soybean Production in Taraba State, Nigeria

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Abstract
This study analyzed the sustainability and constraints associated with soybean production in Taraba State, Nigeria. The specific objectives were to: ascertain the sustainability of soybean production and examine the challenges of soybean production in the study area. Multistage, purposive and simple random sampling techniques were used to select 240 respondents for the study. Data for this study was collected using structured interview schedule (questionnaire). The objectives of the study were achieved using income contribution and principal component analysis. The result obtained from the study revealed an average sustainable index of 0.748 which implies that the business sustainability performance is adjusted regularly to the sustainability goals and has significant improvements potentials. The result also showed that all the factors were significant and responsible problems associated with soybean production in Taraba State. It was recommended that farmers should be encouraged by the Government and Non-Governmental organization to participate in soybean production in order to increase the level of output.
Keyword: soybean, production, sustainability, constraints, Taraba State.

Introduction

Soybean (*Zea mays* L) is an annual crop of great importance, it was domesticated from America. It is used as a source of carbohydrate to both human (in the developing countries) and animal feed worldwide due to its high feeding value (Sahel capital, 2017). It is recently used in production of bio fuel. It is equally well accepted for feed ingredient and can contribute up to 30% protein, 60% energy, and 90% starch in animal diet. Soybean is one of the important crops occupying third position next to wheat and rice in cereal production in the world (Khojely, Ibrahim, Sapey and Han, 2018). Soybean has been recognized as a common component in most inters cropping system. It seems to lead as the cereal constituent of intercrop and is regularly combined with dissimilar legumes (Mahendra*et al*., 2018). Soybean yield is generally higher in high solar intensities, lower night temperatures and lower incidence of pest and diseases (Daramola, Adeyemi, Adigun and Adejuyigbe, 2019).

Soybean provides a cheaper and high protein rich alternative substitute to animal protein. The inclusion of soybean in the carbohydrate rich staple food in Nigeria will increase their protein content (Omoigui et al., 2020). Estimates show that about 925 million individuals are undernourished worldwide (FAO 2010). Soybean has the potential to address the needs of these individuals through increased local production and consumption of the crop. Development of locally adapted soybean varieties consumed either as cooked mature seeds or immature green seeds would offer vital nutrients and bring balance to the undernourished diet. Other than the high protein content, it also has good amount of calories and fat. It contains the eight essential amino acids and is a rich source of polyunsaturated fatty acids (including the good fat-omega 3) and is free of cholesterol (Food and Agriculture Organization, 2010b).

Soybean is used as food for home consumption, raw materials for local factories and feed for animal. Soybean crop has relatively high protein content (about 40%) with a good balance of the essential amino acids, unsaturated and non-cholesterol fatty acid (approximately 20%) and contains vitamins such as thiamine, niacin, riboflavin, choline, vitamins E and K, which are necessary for normal body growth and development (Regasa*et al*., 2019). The low national soybean production is caused by several factors, such as: unavailability of land allocation that is definitely and specifically intended for the soybean production system; high-risk soybean farming, low productivity and low soybean farming income; perpetrators of soybean farming of traditional farmers with a small business scale; slow adoption of production technology; and program to increase soybean production which is not focused because the harvest area data is not accurate (Daramola, et al., 2019; Omoigui, et al., 2020). Increasing soybean production in Taraba State not only in terms of productivity but also on price stability has become a challenging factor to soya bean farmers. Efforts to increase productivity through government policies in increasing the competitiveness of domestic soybeans and efficiency of resource use are not feasible. Studies on agricultural efficiency related to soya beans production have been carried out by numerous scholars across developing countries especially in Africa (Omoigui, et al., 2020; Daramola et al., 2019; Regasa*et al*., 2019; Ichaou and Ismaïla, 2016; Upev, *et al*., 2015). Much of the existing literature on efficiency in Soybean has exclusively focused on technical efficiency. However, how farmers allocate their resources in response to price incentive is also an important determinant of profitability of the farming enterprise. In addition, Technical, allocative and economic efficiency are important in improving the productivity gains from existing technologies. To achieve optimum production level, resources available must be used efficiently. Successful planning and result-oriented policies require the technical knowledge of productivities of farm resources to know the needed necessary adjustments to achieve a correct input mix.

Despite its importance, Soybean production in Taraba State is dominated by traditional small scales farmers who use traditional methods of production. Resources are underutilized in addition to use of low yielding varieties, poor extension services, inadequate incentives and amenities, which give rise to low output and hence low farm income (Omoigui et al., 2020; Shehu *et al*., 2017). In addition, farmers might use resources rationally but not at economic optimal level, all these contribute to low output. The small scale production of soybean in Taraba State could be attributed mainly to the relatively small initial capital investment, lack of readily available high yielding varieties and many unresolved and poorly understood issues associated with land ownership. In view of the foregoing, it is proper to examine the economic analysis of small scale soybean production in Taraba State, Nigeria.

Materials and Methods

The study was conducted in Taraba State, Nigeria. Data was collected using structured interview schedules with the aid of questionnaires. Multistage, purposive and simple random sampling techniques were adopted in sampling 240respondents for the study. Exploratory factor analysis and Sellito *et.al* 2010 approach were used to analyze challenges associated with soybean production and sustainability of soybean production respectively.

Model Specification

Measurement of sustainability

The measurement of sustainability in this study follows the approach proposed by Sellito*et al* . (2010) for measuring environmental performance and sustainability. The main objective was to capture, with integrated indicators, the complexity involved in environmental systems and

how this manifests itself systemically. To do this, divide the environmental impact of the operation, in five subsystems, (viz; selection of indicators, homogenization, standardization, weighting and aggregation), attributing relative importance and describing the overall impact and process indicators that are evaluated by experts through the Likert scale. Subsequently, they combined the indicators into a global index which varies between 0 and 100 %.
The sustainability index is given as:

$SI = \sum_{j=1}^{j=3} \sum_{i=1}^{i=n} NP_j GR_j OR_j R_j$ ..... (3.18)

Where,
SI = Sustainability Index
NP = Net profit to total sales
GR = Gross ratio
OR = Operating ratio
Rj = Rate or normalized value of the sustainability indicator
The normalization of the indicators can be done through the formula as given:
Rj=

$$\begin{cases} \frac{X_{ij}}{max\{X_{ij}\}} \text{ if } X_{ij} \text{ satisfies the condition "more is better"; 1 if } X_{ij} \geq \max\{X_{ij}\} \text{ "more is better"} \\ \frac{min\{X_{ij}\}}{\{X_{ij}\}} \text{ if } X_{ij} \text{ satisfies the condition "less is better"; 1 if } X_{ij} \leq \min\{X_{ij}\} \text{ "less is better"} \end{cases}$$

In the case where the indicators are homogenous and do not need a normalization procedure, an improvement potential model which measures the level of sustainability of the soybean business was estimated as follows:

$SI = NP_j * GR_j * OR_j R_j$..... (3.19)

Decision rule: A scale of the sustainability index to give an evaluation of the business

Table 1: Sustainability index performance (SIP) evaluation scale

CSI Range	Evaluation level
$0.95 \leq SIP \leq 1$	Very well: the business sustainability performance is adjusted very well to the goals defined in the organizational strategies
$0.85 \leq SIP < 0.95$	Well: the business sustainability performance is adjusted well to the goals defined with some possibilities of improvement
$0.75 \leq SIP < 0.85$	Regular: the business sustainability performance is adjusted regular to the sustainability goals and has significant improvements potentials
$0.65 \leq SIP < 0.75$	Deficient: is deficient with respect to sustainability goals defined by the organization and has several opportunities for improvement
$0.65 < SIP$	Poor: the business sustainability performance is bad regarding the defined sustainability goals and has large opportunities of improvements

Exploratory factor analysis

Principal component factor analysis with varimax-rotation and factor loading of 0.50 was used. Variables with factor loadings less than 0.50 and variables that loaded in more than one factor was discarded following the study of Madukwe (2004). The principal component factor analysis model is stated thus:

$Y_1 = a_{11}Z_1 + a_{12}Z_2 + * * * + a_1nZn$ - - - - - - - (3.32)

$Y_2 = a_{21}Z_1 + a_{22}Z_2 + * * * + a_2nZn$ - - - - - - - (3.33)

$Y_3 = a_{31}Z_1 + a_{32}Z_2 + * * * + a_3nZn$ - - - - - - - (3.34)

$Yn = an_1Z_1 + an_2Z_2 + * * + anZ_n$ - - - - - - - (3.35)

Where

$Y_1, Y_2 \ldots Yn$ = observed variables / constraints to commercialization

$a_1 – an$ = factor loadings

$Z_1, Z_2, \ldots Zn$= unobserved underlying factors constraining commercialization as follows:

Z_1 = High cost of organic and inorganic fertilizer

Z_2 = High cost of cassava stem

Z_3 = High cost of agrochemicals

Z_4 = Unavailability of labour to carry out farming Activities

Z_5 = Very small output

Z_6 = Low quality of soybean harvested

Z_7 = Very far farm distance

Z_8 = High cost of Transportation

Z_9 = Seasonal price variation

Z_{10} = Bad road network

Z_{11} = Perishability of the product

Z_{12} = Poor storage facilities

Z_{13} = Bulkiness of the goods

Z_{14} = Poor pricing

Z_{15} = Pest and diseases

Z_{16} = Scarcity of farm land

Z_{17} = Instability in government policy

Z_{18} = Lack of technical knowledge in the use of land

Z_{19} = Lack of collateral required to secure loan

Z_{20} = Poor extension agent farmers contact

Z_{21} = Barrier to adoption of farming techniques

Results and Discussion

Economic sustainability of soybean production in the study area;
Corporate Sustainability Index was used to achieve part of objective five, the result was summarized and presented in table 4.9. The purpose is to understand the sustainability level associated with soybean enterprise in the area. The measurement of sustainability in this study follows the approach proposed by Sellito*et al* . (2010) for measuring sustainability. This captured integrated indicators, the complexity involved in environmental systems and how this manifests itself systemically. The environmental impact of the operation, in five subsystems (viz selection of indicators, homogenization, standardization, weighting and aggregation) attributing relative importance and describing the overall impact and process indicators that are evaluated by experts through the five point Likert scale. Subsequently, they combined the indicators into a global index which varies between 0 – 1 (i.e 0 – 100%).

Table 2: Distribution of respondents based on sustainability level

Sustainability level	Frequency	Percentage	Ranking	Evaluation level
0.05 – 0.14	6	2.50	7th	Poor
0.15 - 0.24	9	3.75	6th	Poor
0.25 - 0.34	3	1.25	8th	Poor
0.35 - 0.44	12	5.00	5th	Poor
0.45 - 0.54	6	2.50	7th	Poor
0.55 - 0.64	9	3.75	6th	Poor
0.65 - 0.74	45	18.75	3rd	Deficient
0.75 - 0.84	60	25.00	1st	Regular
0.85 - 0.94	48	20.00	2nd	Well
0.95 – 1.00	42	17.50	4th	Very well
Mean	**0.744**			
Total	**240**	**100.00**		

Source: Field Survey Data, 2020

Table 2 indicates that the values of sustainable index obtained lies between 0 and 1. From the result, the average sustainable index was 0.748 which implies that on the average, the business sustainability performance is adjusted regularly to the sustainability goals and has significant improvements potentials. An index of 0.75 and above are moderate for the enterprise as it allows the enterprise to refocus organizational efforts towards the worst indicators (Frank *et al* ., 2014)

Furthermore, the result shows that about 18.52% of total respondent have sustainability index less than 0.65 unit, this implies that these respondent have poor sustainability level, the implication is that the business sustainability performance is bad regarding the defined sustainability goals and has large opportunities of improvements. Also 18.52% of total respondent have sustainability index between 0.65 – 0.74, this implies that these respondents have deficient sustainability level. The implication is that there is deficient sustainability level

with respect to the sustainability goals defined by the organization and has several opportunities for improvement. About 24.69% of the total respondent have sustainability index between 0.75 – 0.84; which implies that the business sustainability performance is adjusted regularly to the sustainability goals and has significant improvement potentials. About 20.99% of the total respondents have sustainability index between 0.85 – 0.94; which implies that the business sustainability performance is adjusted well to the goals defined with some possibilities of improvement. While 17.28% of the total respondents have sustainability index between 0.95 – 1.00, which implies that these respondents have a very well sustainability level: the implication is that the business sustainability performance is adjusted very well to the goals defined in the organizational strategies. Sustainable development indicators and composite indicators are considered to be a good vehicle in helping to measure sustainable development and progress achieved in the enterprise (UNCSD, 2012)

Challenges of Soybean Production Business

The problems associated with credit access and utilization are shown in Table 3 below:

Table 3. Problems associated with credit access and utilization

Challenges	**Factor** 1	**Factor** 2	**Factor** 3	**Factor** 4	**Factor** 5	**Factor** 6	**Factor** 7
Z_1 = High cost of fertilizer	0.363	0.239	0.294	-0.237	0.251	0.369	0.348
Z_2 = High cost of seed	0.601*	0.495	0.03	-0.269	0.257	-0.102	-0.126
Z_3 = High cost of agrochemicals	-0.4	0.142	-0.12	0.112	0.408	-0.244	-0.556*
Z_4 = Unavailability of labour	0.598*	0.511*	0.109	-0.321	0.203	-0.157	0.053
Z_5 = Very small output	0.617*	0.357	0.204	-0.112	-0.123	-0.456	-0.119
Z_6 = Low quality of soybean harvested	0.365	0.328	-0.572	0.101	0.12	0.283	0.048
Z_7 = Very far farm distance	0.698*	0.201	-0.3	0.207	-0.406	-0.012	0.032
Z_8 = High cost of Transportation	0.029	-0.069	-0.429	0.487	-0.376	0.225	-0.102
Z_9 = Seasonal price variation	0.688*	0.404	-0.218	0.052	0.069	0.151	0.028
Z_{10} = Bad road network	-0.096	0.291	-0.333	0.037	0.507*	0.472	-0.327
Z_{11} = Perishability of the product	0.653*	0.299	-0.152	0.226	-0.334	-0.083	-0.104
Z_{12} = Poor storage facilities	-0.342	0.443	-0.171	0.02	0.041	-0.353	0.227
Z_{13} = Bulkiness of the goods	-0.578*	0.583*	-0.096	0.095	-0.053	0.007	0.148
Z_{14} = Poor pricing	0.143	-0.154	-0.035	0.491	0.391	-0.097	0.531*
Z_{15} = Pest and diseases	-0.641*	0.613*	-0.097	0.068	-0.068	-0.077	0.238
Z_{16} = Scarcity of farm land	-0.601*	0.544*	-0.099	-0.143	-0.106	0.138	0.207
Z_{17} = Instability in government policy	0.075	0.222	0.446	0.575*	0.041	-0.02	-0.074
Z_{18} = Lack of technical knowledge	-0.214	0.462	0.578*	0.059	-0.283	0.355	-0.254
Z_{19} = Lack of collateral required	0.343	-0.05	0.601*	0.173	0.003	0.33	0.084
Z_{20} = Poor extension contact	-0.343	0.637*	0.255	0.271	-0.08	-0.078	-0.105
Z_{21} = Barrier to adoption of techniques	0.187	-0.05	0.137	0.691*	0.374	-0.177	-0.01

***Source: Field survey, 2021 * factor reach* cut off point for factor loadings/Eigen**

Seven factors/principal Components were extracted based on the responses of the respondents. The Kaiser criterion was employed for selecting the number of underlying factors or Principal Components explaining the data. The number was decided by leaving out components/loadings with corresponding Eigen values of less than 0.50. Only variables with factor loadings of ≥0.50 were used in naming the factors/principal Components. Variables that have factor loadings of < 0.50 were not used while variables that loaded in more than one constraint were also discarded.

The loadings under factor 1 were; High cost of seed (0.601), Unavailability of labour (0.598), Very small output (0.617), Very far farm distance (0.698), Seasonal price variation (0.688), Perishability of the product (0.653), Bulkiness of the goods (0.578), Pest and diseases (0.641), and Scarcity of farm land (0.601). The loadings under factor 2 include Unavailability of labour (0.511), Bulkiness of the goods (0.583), Pest and diseases (0.613), and Scarcity of farm land (0.544). The third factor include lack of technical knowledge (0.578) and lack of collateral required (0.601). The fourth factor include instability in government policy (0.575) and barrier to adoption of techniques (0.691). The fifth factor is bad road network (0.507) and seventh factor is high cost of agrochemical (0.556).

Table 4: Total variance explained on problems associated with credit access

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	**% Variance**	**ofCumulative %**	**Total**	**% of Variance**	**Cumulative %**
Z_1 = High cost of fertilizer	4.485	21.355	21.355	4.485	21.355	21.355
Z_2 = High cost of seed	3.108	14.798	36.153	3.108	14.798	36.153
Z_3 = High cost of agrochemicals	1.976	9.409	45.562	1.976	9.409	45.562
Z_4 = Unavailability of labour	1.792	8.533	54.095	1.792	8.533	54.095
Z_5 = Very small output	1.447	6.888	60.983	1.447	6.888	60.983
Z_6 = Low quality of soybean	1.254	5.970	66.954	1.254	5.970	66.954
Z_7 = Very far farm distance	1.139	5.425	72.378	1.139	5.425	72.378
Z_8 = Transportation	0.892	4.249	76.627			
Z_9 = Seasonal price variation	0.807	3.844	80.470			
Z_{10} = Bad road network	0.730	3.474	83.944			
Z_{11} = Perishability	0.613	2.918	86.862			
Z_{12} = Poor storage facilities	0.518	2.465	89.327			
Z_{13} = Bulkiness of the goods	0.401	1.912	91.239			
Z_{14} = Poor pricing	0.352	1.677	92.916			
Z_{15} = Pest and diseases	0.332	1.580	94.496			
Z_{16} = Scarcity of farm land	0.277	1.319	95.815			
Z_{17} = Government policy	0.265	1.260	97.074			
Z_{18} = technical knowledge	0.205	0.977	98.051			
Z_{19} = Lack of collateral required	0.153	0.726	98.777			
Z_{20} = Poor extension contact	0.134	0.639	99.416			
Z_{21} = adoption of techniques	0.123	0.584	100.000			

Extraction Method: Principal Component Analysis.

After rotation, the first factor accounted for 21.355% of the variance of the problems associated with credit access and investment, the second factor accounted for 14.798% of the

variances, the third factor accounted for 9.409% of the variance of problems associated with soybean production and the fourth factor accounted for 8.533% of the observed variances. The fifth factor accounted for 6.888% of the variance of problems associated with soybean production, the sixth factor accounted for 5.970% of the observed variances and the seventh factor account for 5.425% of total variation. The four factors explained 72.378% of the variances problems associated soybean production.

Table 5: Communalities Scores on problems associated with credit access

Problems	Initial	Extraction
Z_1 = High cost of fertilizer	1.000	0.652
Z_2 = High cost of seed	1.000	0.771
Z_3 = High cost of agrochemicals	1.000	0.742
Z_4 = Unavailability of labour	1.000	0.802
Z_5 = Very small output	1.000	0.799
Z_6 = Low quality of soybean harvested	1.000	0.674
Z_7 = Very far farm distance	1.000	0.827
Z_8 = High cost of Transportation	1.000	0.630
Z_9 = Seasonal price variation	1.000	0.715
Z_{10} = Bad road network	1.000	0.793
Z_{11} = Perishability of the product	1.000	0.719
Z_{12} = Poor storage facilities	1.000	0.520
Z_{13} = Bulkiness of the goods	1.000	0.717
Z_{14} = Poor pricing	1.000	0.731
Z_{15} = Pest and diseases	1.000	0.868
Z_{16} = Scarcity of farm land	1.000	0.760
Z_{17} = Instability in government policy	1.000	0.592
Z_{18} = Lack of technical knowledge	1.000	0.868
Z_{19} = Lack of collateral required	1.000	0.627
Z_{20} = Poor extension contact	1.000	0.686
Z_{21} = Barrier to adoption of techniques	1.000	0.705

Extraction Method: Principal Component Analysis.

Communalities measure the proportion of each variable's variance that can be explained by the principal component. It represents the relationship between the factors and all other variables (i.e., the squared multiple correlation between a factor and all other factors). Principal component analysis works on the initial assumption that all variances are common; therefore before extraction, the communalities must be one. The values in the extraction column indicate the proportion of each variable's variance that can be explained by the principal components. From the Table above, it is observed that Pest and diseases value was 0.868, Very far farm distance was 0.827 and unavailability of labour was 0.802. The result shows that all the factors were significant and responsible problems associated with soybean production in Taraba State, Nigeria. The implication of this result on soybean production is decrease in level of participation in soybean production which also decreases output of farmers.

Conclusion and Recommendations

The enterprise had a sustainability index of 0.748 which implies that the business
Sustainability performance is adjusted regularly to the sustainability goals and has significant improvements potentials. It was also revealed that all the factors were significant and responsible problems associated with soybean production in

Taraba State. Based on the findings from this study, it is recommended that Nigerian government and international development agencies ensure that any intervention has a capacity-building component which should center around environmental and ethnographic research, education about the training on how to interact with soybean farmers and maintain a successful farm, and the development of infrastructure.

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