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PROJECTION AND RESOURCES ADJUSTMENT IN CASSAVA PRODUCTION IN OYO STATE, NIGERIA

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ABSTRACT

Projection was made by the use of ARIMA model, contribution of area and yield towards cassava production was done by decomposition analysis and adjustment in cropping pattern was estimated by calculating index level. Forecast result showed that maximum value of area is 843.0 thousand hectares which would be expected in 2013-14 while minimum value is 826.0 thousand hectares which is likely to occur by the year 2025-26. Production forecast revealed maximum value of 1407.0 thousand tons which would be expected by 2025-26 and the minimum value of 1181.0 thousand tons in 2012-13.

Keywords: Projection, Resource adjustment, Production, Cassava, Oyo State, Nigeria.

Contribution/ Originality

The paper contributes the first logical analysis to determine optimization levels which give maximum return with least cost minimization.

1. INTRODUCTION

Literature review that Cassava is a popular crop that being grow by each households in Nigeria. It has huge cost and return comparative production advantage over other staples crops. Cassava production required less labour per unit of output and Cassava requires low fertile soils for better yield. It is a good staple the nationally required food security minimum of 2400 calories per person per day (Agriculture in Nigeria, 2010).

According to National Survey on Agricultural Indicators at a Glance (2011), Nigeria is ranked among the leading producer of cassava in Africa and rest of the world. The cassava output capacity produced in Nigeria is huge due to the implementation of Government policies and programme that promote rapid growth of cassava and easy marketing channel to the end users. This initiative was used to increase economic growth in Nigeria. Recently, the Nigerian government promulgated a law, making it compulsory for the baker to use composite flower of hundred percent cassavas and ninety percent wheat for bread production.

United Nations Center for Human Settlements (UNCHS – Habitat) (1994) reported that the majority of the world population lived in cities and the cities will continue to be congested unless active measures were put into order. Also, Agriculture System in Africa (2000) also observed same trend of growth in Africa and rest of the world. Developing countries such as Nigeria in particular are facing problems attributed to income generation among the households and these problems hindering the nation to check the rapid growing population.

The present investigation relates to two different zones in Oyo State, where cassava crop is cultivated on ten thousand (10,000) and above hectares of land (Survey on Agricultural Status, 2012) The effective changes in relative position of cassava crop as a competing crop for land resources with other crops is continuously inducing its adjustment in the cropping pattern. This study examines the relative position of cassava and asses its adjustment in the cropping pattern area and production so that the possibilities of acreage and yield expansion may be explored in two different zones (Oyo and Ibadan zones) of Oyo State. The study has become significant for both farmers and policy maker.

For Policy Maker:

- The study will serves as strategies frame work for decision making at state level
- It will also ensure efficient and a clear cut linkage supply system of inputs that will contribute huge quota to the growth of the study area
- This study will enable the government to design clear and feasible programmes and policies that will be in line with agricultural sector needs in the state.

For farmers:

- The farmers can use the study The study will serves as guidelines for allocation of scarce resources during production
- Farmers can also use the study The findings will enable the farmers to determine the optimization levels which gives maximum return with least cost minimization

2. LITERATURE REVIEW ON AGRICULTURAL CROPS PROJECTION

There are relatively few studies that estimate agricultural projection in developing countries such as Nigeria. Most of these have come out with rather surprising and paradoxical results of declining projection in the developing countries even in the years which are well documented for success stories where green revolution varieties of cassava has been widely adopted.

The studies of agricultural projection in developing countries include work done by Badmus and Ariyo (2011); used ARIMA model to forecast area and production of maize in Nigeria. They estimated ARIMA (1, 1, 1) and ARIMA (2, 1, 2) for cultivated area and production respectively. The result shows maize production forecast for the year 2020 to be about 9952.72 tons with upper and lower limits 6479.8 and 13425.64 thousand tons respectively. The model also shows that the maize area would be 9229.74 thousand hectares with lower and upper limit of 7087.67 and 11371.81 thousand hectares respectively by 2020.

Suleiman and Sarong (2012), employed the Box-Jenkins approach to model milled rice production in Ghana using time series data from 1960 to 2010.The analysis revealed that ARIMA (2, 1, 0) was the best model for forecasting milled rice production. Although, a ten years forecast with the model shows an increasing trend in production, the forecast value at 2015 (283.16 thousand metric tons) was not good enough to compare with the current production of Nigeria (2700 thousand metric tons), the leading producer of rice of rice in West Africa.

Najeeb *et al.* (2005) employed Box-Jenkins model to forecast wheat area and production in Pakistan. Their study showed that ARIMA (1, 1, 1) and ARIMA (2, 1, 2) were the appropriate models for wheat area and production respectively.

Falak and Eatzaz (2008) analyzed future prospects of wheat production in Pakistan. They obtained the parameters of their forecasting model using Cobb-Douglas production function for wheat, while future values of various inputs are obtained as dynamic forecasts on the basis of separate ARIMA estimates for each input and for each Province. Kirtti and Goyari (2013); used kink exponential growth rate model to analyse growth rates of area, production and yield of major crops in Odisha for pre-liberalization and post-liberalization periods The results show that all crops, except rice experienced deceleration in area during post-liberalization period. Among those crops, bajra, jowar, wheat, ragi and small millet experienced a higher deceleration. Even the positive growth rate of rice area was very trivial.

3. METHODOLOGY

3.1. Profile of the Study Area

Oyo state is located in latitude 6°55'– 8°45'N and longitude 2°50'–3°56'E respectively in south-western Nigeria, West Africa. It is bound by the Republic of Benin, Kwara state, Osun state and Ogun state on the west, north, east and south respectively. The state has a tropical climate type with distinct periods of wet and dry season. The mean Annual temperature is 21ºC while the annual rainfall ranges from 1000 mm to 1500 mm.

The Wet season is between 230 to 260 days/year. Most soil in Oyo state belongs to the savannah group of soil (Oyo State Land Survey, 1990). In undulating areas, the soil is composed of sand, and sandy loam, while in areas that are nearly level, savannah soil comprises of sandy loam with some gravel. Rainforest soil is found in the southeast part of Oyo state. The soil consists of loam, sandy loam, and clay loam. Oyo State exhibits the typical tropical climate of averagely high temperatures, high relative humidity and generally two rainfall maxima regimes during the rainfall period of March to October. The mean temperatures are highest at the end of the Haematin (averaging 28°C), that is from the middle of January to the onset of the rains in the middle of March. Even during the rainfall months, average temperatures are between 24°C and 25°C, while annual range of temperature is about 6°C.

Rainfall figures over the state vary from an average of 1200mm at the onset of heavy rains to 1800mm at its peak in the southern part of the state to an average of between 800mm and 1500mm at the northern parts of the State (Oyo State ministry of Information report).

The ARIMA model is selected over others model for the study because of the following reasons:

I. It helpsArima model is useful to solve problem associated with redundancy in forecast
II. It provides information about inter-regional and temporal variation
III. It shows the separation between input-output production technology
IV. It shows the boundaries for forecasting (upper and lower limit boundaries).

The crop adjustment for area and yield dominating in the two zones selected in the study area were regrouped into five (see in table 1.1 and 1.2)

Table-1.1. Departure of index from the base

S.N.	Group	Percentage extent of Variation in area or yield	Index level of Area or yield
1.	A	More than 30	Above 130
2.	B	+10 to 30	110 to 130
3.	C	±10	90 to 110
4.	D	-10 to -30	70 to 90
5.	E	Below -30	Up to 70

Sources: Adopted from Box and Jenkins (1970)

Table-1.2. Combination representing different set of situation

S.N.	Crop adjustment Category	Area dominating	Yield dominating
1.	Well-adjusted	AA, BB, CC	DD, EE
2.	Sufficiently-adjusted	AB, BC, CD, DE	BA, CB, DC, ED
3.	Tolerable-adjusted	AC, BD, CE	CA, DB, EC
4.	Poorly-adjusted	AD, BE	DA, EB
5.	Very poorly adjusted	AE	EA

Source: Adopted from Box and Jenkins (1970)

3.2. Model Specification

According to Box and Jenkins, Auto Regressive Integrated Moving Average is the most general class of models for forecasting a time series. The ARIMA model is denoted by ARIMA (p, d, and q),

Where,

p – Stands for the order of the auto regressive process

d – Is the order of the data stationary and

q – Is the order of the moving average process.

The general form of the ARIMA (p,d,and q) can be written as:

$$\Delta^d y_t = \delta + \theta_1 \Delta^d y_{t-1} + \theta_2 \Delta^d y_{t-2} + --- + \theta_p \Delta^d y_{t-p} + e_{t-1} \alpha e_{t-1} - \alpha_2 e_{t-2} \alpha_q e_{t-2} \text{ .... (1)}$$

Where,

Δ^d denotes differencing of order d, i.e., $\Delta y_t = y_t - y_{t-1}$,

$\Delta_t y_t = \Delta y_t - \Delta_{t-1}$ and so forth,

Y_{t-1} …….. Y_{t-p} are past observations (lags),

δ, θ_1 …… θ_p are parameters (constant and coefficient) to be estimated similar to regression coefficients of the Auto Regressive process (AR) of order "p" denoted by AR (p) and written as;

$$Y = \delta + \theta_1 y_{t-1} + \theta_2 y_{t-2} + \text{ ....} + \theta_p y_{t-p} + e_t \text{ .... (2)}$$

Where,

e_t is forecast error, assumed to be independently distributed across time with mean θ and variance $\theta_2 e$, $e_{t-1,}$ e_{t-2} …….. e_{t-q} are past forecast errors,

$\alpha_{1,}$ ……….. α_q are moving average (MA) coefficient that needs to be estimated.

MA model of order q, i.e. MA (q) can be written as

$$Y_t = e_t - \alpha_1 \alpha_{t-1} - \alpha_2 e_{t-2} \text{ ....} \alpha_q e_{t-q} \text{ .... (3)}$$

Box and Jenkins book on forecasting explained that the estimation procedure of the model consists of four (4) steps, namely: identification, estimation of parameters, diagnostic checking and forecasting.

3.2.1. Identification Step

Identification step involves the use of the techniques to determine the values of p, q and d. The values are determined by using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF).

3.2.2. Estimation of Parameters

The second step is the estimation of the model parameters for the tentative models that have been selected.

3.2.3. Diagnostic Checking

Having chosen a particular ARIMA model and having estimated its parameters the fitness of the model is verified. One simple test is to see if the residuals estimated from the model are white noise, if not we must start with other ARIMA model. The residuals were analyzed using Box-Ljung Statistic.

3.2.4. Forecasting

One of the reasons for the popularity of the ARIMA modeling is its success in forecasting. In many cases, the forecasts obtained by this method are more reliable than those obtained from the traditional econometric modeling, particularly for short-term forecasts. An Autoregressive Integrated Moving Average Process model is a way of describing how a time series variable is related to its own past value.

4. RESULTS AND DISCUSSION

The results of the production projection for cassava crop in Oyo state reveals that the production is on the increasing track in the state. The maximum production is 86.4 thousand tons with 206 thousand tons for upper limit and 29 thousand tons for lower limits. Production in Oyo zone shows increasing trend while it is otherwise in Ibadan zone. The maximum production of cassava crop in Oyo is observed in the last year of projection (2025-26) (28.1 thousand tons) while in Ibadan, maximum production (41.8 thousand tons) is in 2012-13 and minimum value of production in the last year of projection (2025-26). The overall result shows that if more area can be allocated to cassava crop in the state, there will be possibility of increasing production. Maximum value of area of cassava in Oyo state is expected to be 53.88 thousand hectares by the year 2025/26 according to the result of projection and the minimum value of 49.30 thousand hectares in 2012/13. Both Oyo and Ibadan zones show increase in acreage with maximum and minimum values of 22.05, 35.21, thousand hectares respectively. In Oyo State, which is mainly maize and cowpea growing region of Oyo state, the share of cassava crop in the gross cropped area is 3.95 percent. The percentage of cassava crop to gross cropped area in Oyo and Ibadan zones are 4.20 per cent and 4.74 percent respectively.

Table-1.3a. Forecast for Cassava area in Oyo State

Zones / Years	OYO			IBADAN			Combine		
	FA	UL	LL	FA	UL	LL	FA	UL	LL
2012-13	21032	22763	19404	28413	32378	24835	49298	52633	46129
2013-14	21211	23476	19119	28824	33773	24456	49564	54943	44602
2014-15	21362	23957	18990	29265	34703	24511	49964	56542	43994
2015-16	21490	24305	18933	29731	35460	24746	50268	58128	43257
2016-17	21597	24566	18913	30218	36147	25070	50648	59513	42841
2017-18	21687	24765	18914	30722	36808	25446	50976	60881	42365
2018-19	21763	24918	18926	31241	37461	25852	51346	62164	42045
2019-20	21827	25039	18943	31774	38116	26280	51689	63429	41705
2020-21	21881	25134	18964	32318	38778	26724	52057	64653	41448
2021-22	21927	25210	18984	32874	39448	27182	52411	65862	41189
2022-23	21965	25271	19004	33441	40128	27650	52779	67048	40981
2023-24	21998	25320	19023	34019	40819	28130	53141	68223	40777
2024-25	22025	25359	19039	34607	41522	28618	53512	69386	40605
2025-26	22048	25392	19055	35206	42236	29117	53881	70541	40441

Area in hectares FA: Forecasted Area, UL: Upper limits and LL: Lower limits

Ibadan zone is area dominating while Oyo zone is yield dominating. Ibadan is well-adjusted and shared 50.59 percent of the area in the state while Oyo is sufficiently-adjusted and shared 49.21 percent of the area in the state. The result is in line with published articles on Food Security Scenario in Africa (2000).Forecast result showed that maximum value of area is 843.0 thousand hectares which would be expected in 2013-14 while minimum value is 826.0 thousand hectares which is likely to occur by the year 2025-26. Production forecast revealed maximum value of 1407.0 thousand tons which would be expected by 2025-26 and the minimum value of 1181.0 thousand tons in 2012-13.

Area Projection for Oyo state

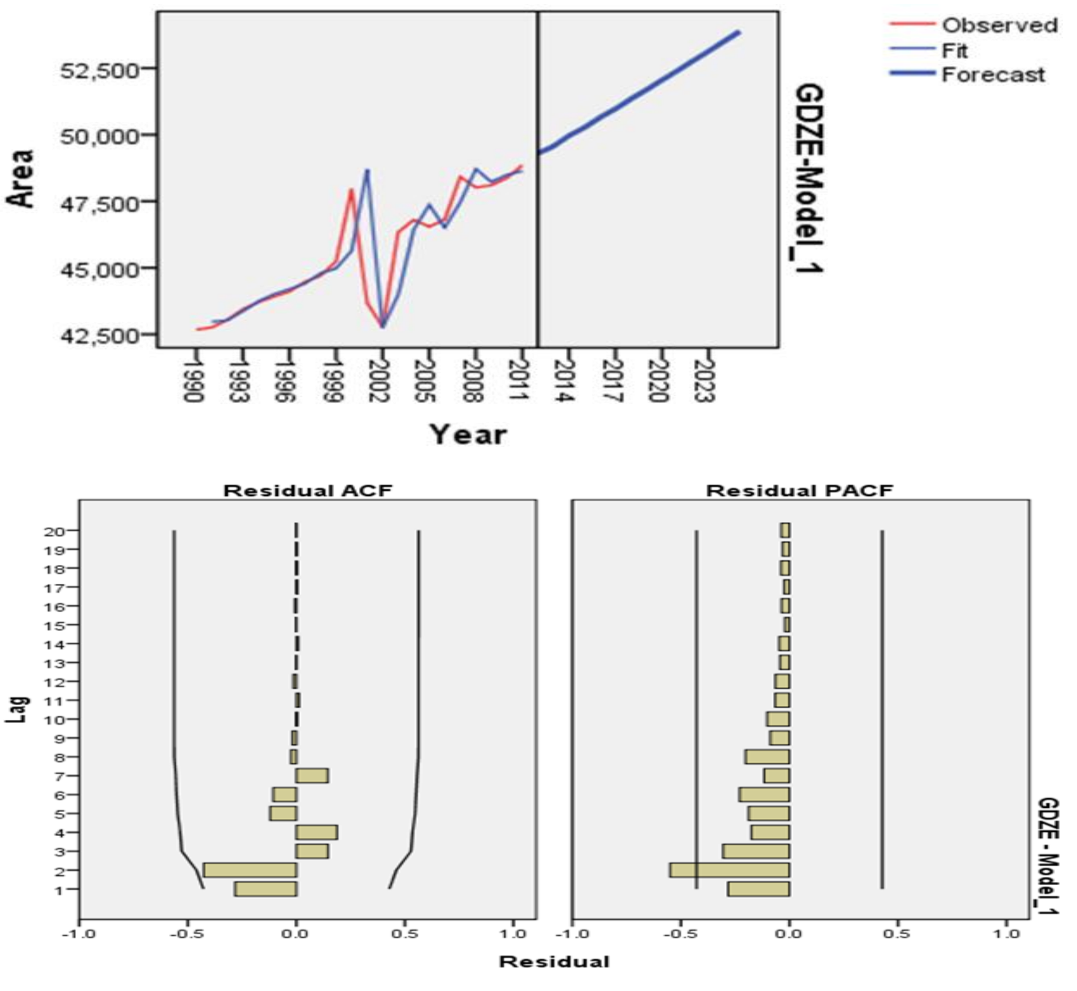


Table-1.3b. Forecast for Cassava production in Oyo state

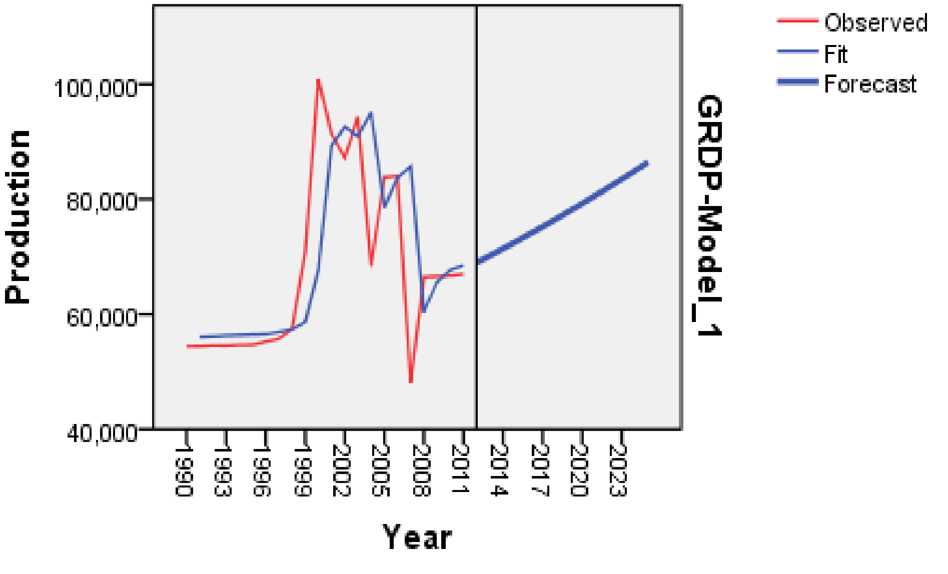
Zones / Years	Oyo			Ibadan			Combine		
	FP	UL	LL	FP	UL	LL	FP	UL	LL
2012-13	23025	30923	16785	41789	63237	26443	68963	100018	45936
2013-14	23852	39779	13371	41176	64120	25153	70171	108740	43125
2014-15	23948	44306	11709	40645	64531	24238	71400	117030	40899
2015-16	24408	49886	10388	40188	64663	23566	72651	125094	39053
2016-17	24697	54562	9379	39795	64632	23062	73923	133047	37478
2017-18	25078	59477	8543	39459	64510	22676	75218	140958	36106
2018-19	25422	64167	7842	39171	64341	22376	76535	148877	34892
2019-20	25792	68921	7239	38925	64151	22141	77876	156838	33806
2020-21	26157	73632	6715	38715	63958	21955	79240	164866	32824
2021-22	26533	78382	6253	38536	63772	21805	80628	172983	31931
2022-23	26912	83148	5842	38384	63598	21685	72040	181205	31112
2023-24	27298	87956	5474	38254	63440	21587	83477	189547	30358
2024-25	27689	92805	5142	38144	63297	21508	84939	198020	29660
2025-26	28086	97705	4841	38050	63170	21442	86427	206636	29011

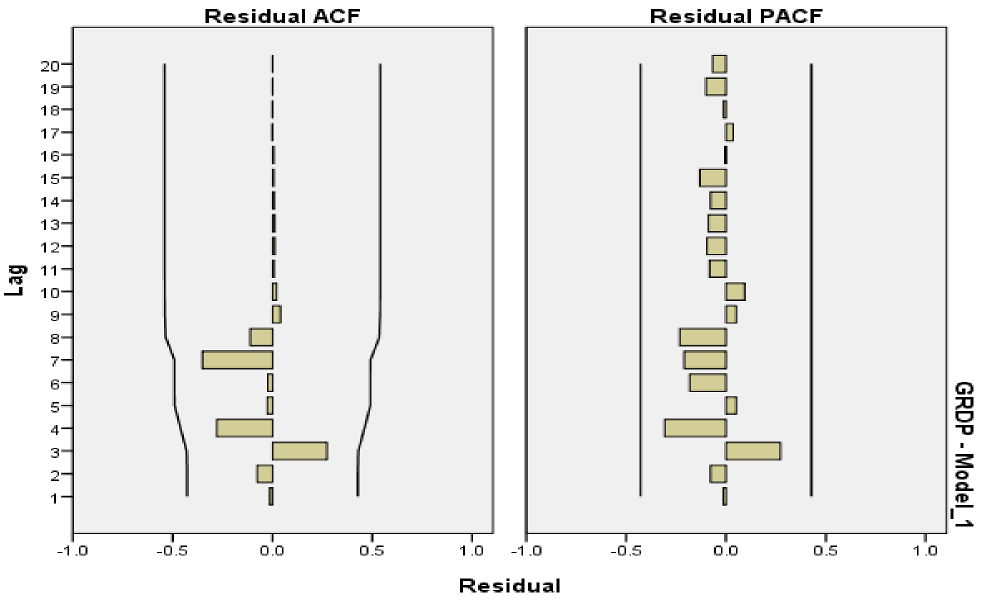
Production in tons FP: Forecasted production, UL: Upper limits and LL: Lower limits

Table-1.3c. Area and yield index of cassava in Oyo state

Zones	Area ('000 ha)	Yield (kg/ha)	GCA ('000 ha)	% of cassava area to GCA	Area index	Yield index
Oyo	20.48	1150.39	488.03	4.20	90.46	113.27
Ibadan	27.96	1541.49	589.46	4.74	138.52	149.84
Oyo state	48.45	1377.71	1077.49	4.50	113.12	108.35

Production Projection for Oyo state





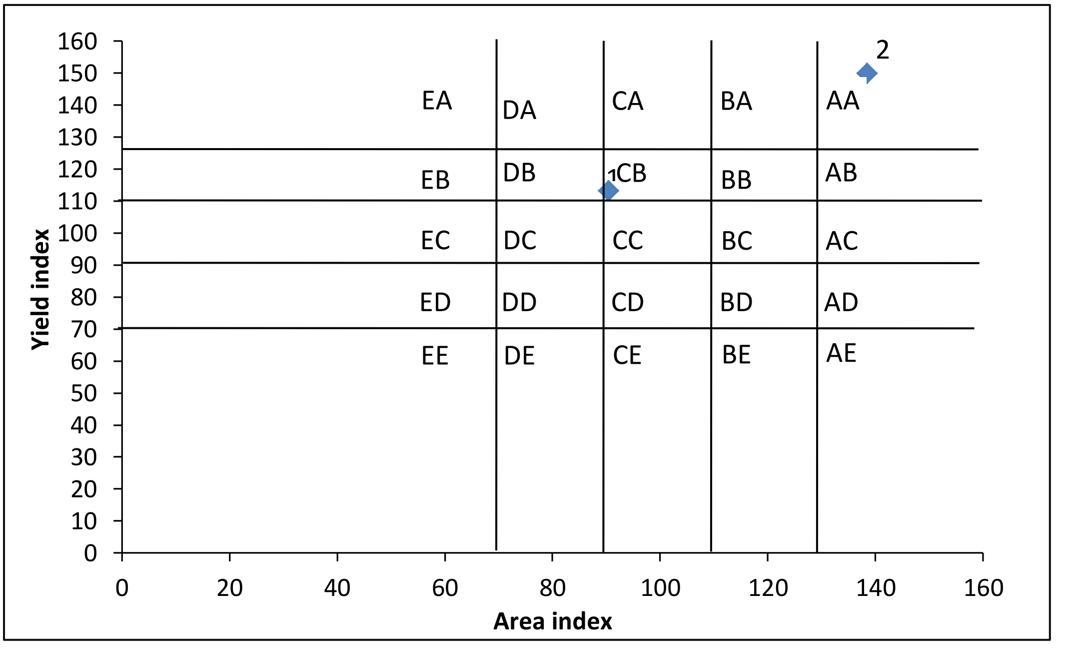


Fig-1. Placement of zones in Oyo state according to crop adjustment categories

Oyo state: - Oyo (1) and (2) Ibadan (source: field survey, 2013).

Table-1.3d. Placement of zones in Oyo state according to crop adjustment categories

Particulars	Category					Total
	I	II	III	IV	V	
Area dominating zones	Ibadan	-	-	-	-	1
Yield dominating zones	-	Oyo	-	-	-	1
% of cassava area in the Oyo state	50.79	49.21	-	-	-	100
% of cassava area in the state	3.15	3.05	-	-	-	6.20

Source: field survey 2013

5. CONCLUSIONS

The projection of cassava crop production by 2025-26 was estimated around 1407.0 thousand tons but this can be increased, if the present decline in acreage which is expected to be 826.0 thousand hectares by 2025-26 as against 841.0 thousand hectares in 2012-13 turns from declining and the growth in productivity is maintained by expansion of area under hybrid cassava.

The results of placement of cassava crop in the cropping pattern shows that this crop was still sufficiently and tolerably adjusted in the cropping pattern and this leads to think over the possibility of further increase in cassava production in the state by bringing more industries for production of cassava based products.

6. RECOMMENDATIONS

- A comprehensive survey may be undertaken by the competent agencies to identify the problem faced in cultivation of cassava crop in the selected zones of the state. It is because the study was unable to cover all the zones in the study area due to insufficient funding.
- Intensive problem oriented research should be planned and conducted for cassava crop so that appropriate and economically sound package of cultivation practices can be developed and recommended for each zone separately with the consideration of variation in the climate, soil type and available resources. This will solve the problem of variability in income among the cassava growers.
- Efforts should also be made to intensify cassava production especially in the zone where the productivity levels at present is poor. It is because the channel for delivery of incentives provide by Government is not effective due to high corruption. Therefore the socioeconomic condition of the cassava grower remains stagnant without improvement and this resulted to low productivity.

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