

**PRODUCTION SYSTEM AND VARIETAL EFFECTS ON POTATO PRODUCTION IN JOS PLATEAU, NIGERIA**

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**ABSTRACT**

*To address the problem of potato production in Nigeria, the Potato Research Programme of National Root Crops Research Institute, Umudike was established in Kuru, Jos in 1976. Data was collected with the aid of a structured questionnaire from 182 respondents involved in the study. The aims of this study were to test production system effect in potato production and varietal effect on potato production. The potato production systems were Furrow/Flood Irrigation and Manual Watering and the varieties were Nicola, Lady Christy and Empi (Local Variety). Chow's F-test was carried out to test for the stability of the production functions estimated. The calculated Chow's F-statistic were 8.529, 9.783 and 14.690 and they were all statistically significant at 1 percent. This implied that there was a structural shift in the production function of potato in Jos Plateau. So it can be safely stated that the introduction of new potato varieties (Nicola and Lady Christy) caused an upward shift in the Empi (Local variety) production function. Similarly, the Chow's F-test for the potato varieties in the two production systems were statistically significant at 1 percent. This confirmed that there were significant differences between the varieties (Nicola, Lady Christy and Empi) under the Furrow/Flood Irrigation and Manual watering production systems. New potato varieties that are high yielding and disease resistant should be introduced to enhance farmers' productivity and income. Potato farmers' should be encouraged to use both furrow/ flood irrigation and manual watering production systems for increased potato production in the study area.*

**Keywords:** Production system, Varietal effects, Potato production

**INTRODUCTION**

Potato (*Solanum tuberosum* L.) was first introduced in Nigeria in the late 19<sup>th</sup> century, through missionary activities. The production was encouraged by the British Colonial Government during the Second World War as the tubers are needed to feed their armed forces in West Africa. (Ugonna, Jolaoso & Onwualu, 2013). Over the years a number of European varieties were introduced into the country through different sources and they include pinepernel, ackersegen, dekema and roslin eburu. These varieties did not perform as well as they would in their natural environment. In the early 1970's, another set of potato varieties was imported from Europe by Benue/ Plateau State Ministry of Agriculture, they are: ajax, mirka, spunta, Nicola, desiree, diamant, dan-cameroon, alpha, cardinal and Baraka. Between 1973 and 1976, some new varieties were developed

through breeding ( Rc 767-2, Rc 767-4, Rc 776-2 and Rc 777-3). They were popular among farmers' because of their high yields, high dry matter content and cooking qualities. In 1986, Plateau State Ministry of Agriculture imported the following varieties : kondor, bertita, delcora, vento, famosa and romano ( Okonkwo, Amadi & Nwosu, 2009). Since then, potato production is in the hands of small holder farmers and these farmers obtain an average yield of 4.65 t/ha which is almost 40% of the potential tuber yield obtained in research fields. The low yield is caused by the following: small land area cultivated, low soil fertility, poor management practices, prevalence of pests and diseases, poor organized seed supply and tuber storage, high cost of production inputs, marketing problems and poor funding of research. (Fawole and Akoroda, 2000, Aniedu and Onyenwaku, 2008, Aniedu and Onyenwaku, 2009, Ugonna et al, 2013).

To address the problem of potato production in Nigeria, the Potato Research Programme of National Root Crops Research Institute, Umudike was established at Kuru, Jos in 1976. (Okonkwo, Ene & Okoli, 1995). According to Ifenkwe (1981), Okonkwo(1992) and Ayodele (2005), farmers' yield have progressively increased from 5 tonnes per hectare in 1973 to about 14.17 tonnes per hectare in 2000. These improved yields reflect the gains which have been made over the years in breeding and selection of high yielding varieties that are resistant to major pests and diseases, and improved quality of planting materials. The objectives of this study were to test for production system effect in potato production and to test varietal effects in potato production in the Jos Plateau.

## **METHODOLOGY**

A multi-stage random sampling technique was used in the selection of respondents. Four Local Government Areas were randomly selected from the eight that made up Plateau State. (Barkin Ladi, Jos South, Mangu and Bokkos). Two villages were randomly selected from each local government area and thirty households were randomly selected from each village. This gives a total of 240 households. This study was carried out in the 2010 planting season.

Primary data were collected using structured questionnaire. However, only 182 respondents were used for the analysis of results for this paper. The potato production systems were Furrow/Flood Irrigation and Manual Watering, while the varieties of potato used in the study were Nicola, Lady Christy and Empi (Local Variety). Cobb-Douglas Production Functions were estimated for the production systems and varieties.

The equation is stated as follows:

$$\ln Y = \ln a_0 + a_1 \ln X_1 + a_2 \ln X_2 + a_3 \ln X_3 + a_4 \ln X_4 + a_5 \ln X_5 + U_i$$

Where:

Ln = Natural Logarithm

Y = Yield of Potato (kg/ha)

X<sub>1</sub> = Weight of Potato Seed (kg/ha)

X<sub>2</sub> = Fertilizer Input (kg/ha)

X<sub>3</sub> = Labour Input (Mondays/ha)

$X_4$  = Capital Input (N/ha)

$X_5$  = Farm Size (ha).

$a_0$  = The intercept,  $a_1$ -  $a_5$  = estimated coefficient of the inputs, and  $U_i$  is the error term.

Three production functions were estimated: Production function for the old potato production system or potato variety; Production function for the new production system or variety; Production function for the pooled i.e old and new potato production systems and varieties combined.

Chow's test was carried out to test for the stability of the production functions using the formula stated below:

$$F = \frac{RSS_P - (RSS_O + RSS_N)/K}{RSS_O + RSS_N / n - 2k}$$

Where:

$RSS_P$  = Residual Sum of Squares (Pooled)

$RSS_O$  = Residual Sum of Squares (Old)

$RSS_N$  = Residual sum of Squares (New)

$K$  = Number of estimated parameters

$n$  = Number of observation

Production systems effect were determined by comparing production functions of the same variety grown in each system during a given season, while varietal effects were determined by comparing production functions of different varieties grown in the same system( Onyenwaku, 1997). The Chow test basically tests whether the single regression line or the two separate regression lines fit the data best. The main restriction assumed in the Chow test is equality of error variances in two linear regression equations. Application of the Chow test requires that the number of observations in both sub-samples should be nearly the same.

The main hypothesis in the Chow test is that the coefficients are equal for both sub-samples. ie,  $H_0 : \beta_g - \beta_j = 0$

If the test statistic (  $F^*$  ) is greater than the respective  $F$  – statistic at 5% level of significance, the null hypothesis should be rejected. Consequently, the relevant conclusion is that the sub-samples are significantly different. This is the statistical evidence which justifies the decision to estimate separate models for the sub-samples and even make comparisons with results of the whole sample analysis ( Otieno,Omiti,Nyanamba & McCullough, 2009 ).

**RESULTS AND DISCUSSION**

**Table 1. Test for Production System Effect in Potato Production**

System	Variety	$\Sigma e^2$	Df	F-Calculated
Furrow/Flood Irrigation	Nicola	14.349	26	8.529***
Manual Watering	Nicola	6.950	24	
Pooled		24.796	56	
Furrow/Flood Irrigation	Lady Christy	5.836	24	9.783***
Manual Watering	Lady Christy	3.656	24	
Pooled		11.429	54	
Furrow/Flood Irrigation	Empi (Local)	3.831	24	14.690***
Manual Watering	Empi (Local)	6.419	24	
Pooled		13.383	54	

\*\*\* Significant at 1% level.

The results of the statistical tests for differences in production systems for the different potato varieties are presented in Table 1 above. The calculated Chow's F-statistic were 8.529, 9.783, and 14.690. They were all significant at 1 percent for Nicola, Lady Christy and Empi (Local Variety) grown in the two production systems.

We therefore accept that the production functions of the three potato varieties differ significantly in the two production systems. This implied that there was a structural shift in the production function of Potato in Jos Plateau.

Consequently, we can safely say that the introduction of new potato varieties (Nicola and Lady Christy) caused an upward shift in Empi (Local Variety) production function.

**Table 2. Test For Varietal Effects in Potato Production.**

System	Variety	$\Sigma e^2$	Df	F-calculated
Furrow/Flood Irrigation	Empi Vs Nicola	14.349	26	6.058***
Furrow/Flood Irrigation	Empi Vs Lady Christy	5.836	24	18.03***
Furrow/Flood Irrigation	Empi	3.831	24	
Pooled		31.412	86	
Manual watering	Empi Vs Nicola	6.950	24	8.072***
Manual Watering	Empi Vs Lady Christy	3.656	24	13.338***
Manual Watering	Empi	6.419	24	
Pooled		26.879	84	

\*\*\* Significant at 1% level

The results of varietal effects in potato production are shown in Table 2 above. For Nicola, Lady Christy and Empi (Local Variety) grown under Furrow/Flood Irrigation production system, the calculated Chow's F-ratios were 6.058 and 18.03 and they were

statistically significant at 1 percent level. This confirms the fact that there were significant differences between the varieties (Nicola, Lady Christy and Empi) grown under the Furrow/Flood Irrigation production system.

Similarly, significant varietal effects were confirmed for Nicola, Lady Christy and Empi grown under Manual Watering production system. The calculated Chow's F-ratios were 8.072 and 13.338 which were also statistically significant at 1 percent level.

## **CONCLUSION AND RECOMMENDATIONS**

The aims of this study were to test for production system effect on potato production and test for varietal effects in potato production in Jos Plateau during the 2010 cropping season. The potato production systems were Furrow/Flood Irrigation and Manual Watering, while the potato varieties were Nicola, Lady Christy and Empi (Local Variety). Chow's F-test was carried out to test for the stability of the production functions. The values of the chow's F-statistic for the production systems were 8.529, 9.783 and they were all statistically significant at 1 percent level. This implied that there was a structural shift in the production functions of potato in Jos Plateau. So the introduction of Nicola and Lady Christy varieties shifted upwards the production function of Empi (Local Variety). Similarly, there were significant differences between the varieties (Nicola, LadyChristy and Empi) grown in the two production systems (Furrow/Flood Irrigation and Manual Watering).

## **RECOMMENDATIONS**

Introduction of new high yielding and disease resistant varieties of potato should be encouraged to enhance potato productivity and hence farmers' income. Potato farmers' should be encouraged to use both furrow/ flood irrigation and manual watering production methods for increased potato production in the study area.

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