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Production Efficiencies of the Nigerian Agricultural Insurance Corporation Beneficiaries

A Case Study of Livestock Farmers in Kwara State, Nigeria

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Abstract: *Livestock farmers are faced with various risks which is because agriculture largely depends on nature. In solving this the Federal Government of Nigerian established the Nigerian Agricultural Insurance Corporation(NAIC). The objectives are to compare the technical efficiency and output of the beneficiaries and non-beneficiaries of NAIC, determine the levels of production efficiency of the beneficiaries and non-beneficiaries, identify the determinants of production efficiency of beneficiaries and non-beneficiaries and identify the constraints encountered by the beneficiaries in the study area. The research was carried out in Kwara state, Nigeria. The target population was the livestock farmers in Kwara state. A random sampling technique was used to select 160 farmers. Eighty farmers were selected based on the beneficiaries list obtained from NAIC head office in the state and eighty non-beneficiaries were selected using snowball sampling technique. The research instrument used was questionnaire. The analytical tools employed were descriptive statistics, t-test and stochastic frontier model. The results showed that the mean technical efficiency of the beneficiaries and non-beneficiaries were 0.87 and 0.54 respectively. This shows that the beneficiaries were more efficient than non-beneficiaries which implies that their involvement in insurance were of great benefits. The major risks encountered by majority of the livestock farmers are drought, variation in yield, diseases and pests. The constraints encountered include; fear that their claims may not be paid, attitude of NAIC, strict insurance policy. Therefore, it is recommended that insurance workforce should develop strategies like awareness creation that will encourage more participation in the insurance program among farming households.*

Keywords: *Efficiency, Livestock Farmers, Insurance, Nigeria.*

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Introduction

Agricultural productivity is a measure of efficiency. In this context, optimal productivity is a measure of resources in the production process. Agricultural productivity is thus defined as a measure of the efficiency with which an agricultural production system employs land, labour, capital and other resources. The poor in developing countries are the most exposed to and affected by natural hazards. They have limited or no access to insurance and financial services, and in most cases have to manage weather risks by their own means (Syroka and Wilcox, 2006; Pelling, 2007). This is often seen as a primary cause for what has been called the "poverty trap". There are two types of efficiency as recorded by Farell (1957); technical and allocative efficiency. The measurement of a farm specific

technical efficiency is based upon deviations of observed output from the best production or efficient production frontier.

As against two types of efficiency identified by Farell (1957), Olayide and Heady (1982) revealed three types of efficiency to be technical efficiency, economic efficiency and allocative efficiency. Technical efficiency is the ability of a farm to produce a give level of output with a minimum quantity of inputs under a given technology.

Efficiency analysis is generally associated with the possibility of farms producing a certain level of output from a given bundle of resources or certain level of output at least cost. Maximum efficiency is attained when it becomes impossible to reshuffle a given resource combination without decreasing the total output (Adeoti, 2001; Adebayo, 2006).

Productivity in agriculture is measured as the ratio of final output (in appropriate units), to some measure of inputs. However, measures of productivity can be divided into partial or total measures depending on the number of inputs under consideration. Total output as a ratio of some measure of labour quantity usually, in man-days in developing countries is called labour productivity and provides some notion of output per worker; while output per area of land planted is land productivity (Zepeda, 2001; Wiebe, *et al.,* 2003). Diewert and Nakamura (2003; 2005), opined that land productivity and labour productivity are examples of single factor productivity (SFP), which is defined as the ratio of a measure of output quantity to the quantity of a single input used. Partial measures of productivity can be misleading because it ignores the importance of other inputs in any observed output changes (Zepeda 2001). Because of this limitation, a total measure of productivity was designed to be total factor productivity (TFP), which is defined as the ratio of a measure of total output quantity to a measure of the quantity of the total input (Zepeda 2001; Wiebe, *et al.,* 2003).

Increasing agricultural productivity requires one or more of the following: an increase in the input and output with increasing proportionately more than inputs; an increase in output while inputs remain the same; a decrease in both the output and input with input decreasing more; or decreasing input while output remains the same (Adewuyi, 2006; Oni, *et al.,* 2009).

In recognition of the specialized nature of this type of insurance, insurance companies operating in the market either have dedicated agribusiness units or outsource the underwriting to agencies that specialize in it. There are several features of this type of insurance that validate it being treated as a special line of business.

Difficulties in achieving adequate diversification because of the nature of the risk, asymmetries of information in underwriting, the geographical dispersion of agricultural production and the complexity of the biological processes of production, which requires skilled and expert underwriting justify it being considered a special business line (Iturrioz, 2009). According to Falola (2015), total factor productivity was employed in determining the level of farm output produced from inputs available to farmers.

Methodology

Study Area. The study was carried out in Kwara state of Nigeria which is positioned between latitudes 7. 20’ and 11 05’ north of the equator and between longitudes 2.5 and 6 45‘east of the prime Meridian in the Mid-North-Western part of Nigeria. It is bordered in the North by Sokoto and Niger states, and the Federal Capital Territory, and in the South by Oyo, Osun, Ekiti and Edo States. The western boundary is Republic of Benin, while the eastern boundary consists of Plateau and Benue states. Kwara state has a inhabitants of 2.37million (NPC, 2006) and a land area of approximately 32,500 square kilometers with three major ethnic groups, namely, Yoruba, Nupe and Baruba (KWADP 2000), with the climate being intermediate between the edges of dryness, coolness and hotness. The mean monthly rainfall ranges between 50.8mm through the wettest months and 24.13mm all through the driest time.

The minimum average temperature in the state ranges between 21˚C while maximum average temperature range around 30˚C and 35˚C (KWADP 2000). Impact study Kwara Agricultural Development Project (KWADP) report for 1989-1993, 75% of Kwara state population lives in the local areas. 90% of the rural populace engages in various sizes and forms of agricultural activity. The state possesses about 185,000 farm families with an average of 6 or 7 people per farm family. The state is divided into four zones (A,B,C,D) by the KWADP.

***Sampling Techniques*.** The target populace of this study is livestock farmers in Kwara state. The information about the beneficiaries were obtained from the NAIC head office in the state purposively and the Microfinance banks give loans in the state while that of the non-beneficiaries were obtained using snowball sampling technique by contacting the farmers individually. Eighty farmers were selected from the lists of insured livestock farmers gotten from KCMB while eighty non-insured farmers were also selected across the state making the total of 160 farmers.

***Data Collection*.** For this study primary data was used. Primary data were sourced from the farmers that insured using a structured questionnaire and those that did not insure. The lists of insured farmers were obtained from Nigeria Agricultural Insurance Corporation (NAIC) Ilorin Branch Office and Microfinance Banks (KCMB).

Data Analysis Techniques

Descriptive Statistics. The data was presented in tabular and descriptive forms. Descriptive statistics like frequency distribution, percentages, averages and ranking techniques was used to identify the constraints encountered by the beneficiaries in the study area.

Student's t –test of Significance
T-test statistics was used for comparing the technical efficiency and output of the beneficiaries and non-beneficiaries of NAIC in the study area. The formula is given as:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2 + s_{21}^2}{n_1 + n_1}}} \quad \text{..... (i)}$$

- Where,
- $\bar{X}_1$ = Mean of X_1 variable (non-beneficiaries)
- $\bar{X}_1$ = Mean of X_2 variable (beneficiaries)
- S^2_1 = Variance of X_1 variable
- S^2_2 = Variance of X_2 variable
- n_1 = Number of beneficiaries' respondents
- n_2 = Number of non-beneficiaries respondents

The stochastic Frontier Production and Cost Functions
The stochastic frontier model of Cobb-Douglas functional form was used to compare the level of production efficiency of both the beneficiaries and the non-beneficiaries as well as identifying the determinant of production efficiency of the beneficiaries and non-beneficiaries (Objective II & III). The Cobb-Douglas functional form was used because the functional form meets the condition of being self-dual, it allows examination of economic efficiency and it has been applied in many empirical studies (Battese & Coelli, 1988; Amaza & Olayemi, 2002; Ambali et al., 2012). The Cobb-Douglas production functional form is specified as;

The stochastic Frontier Production and Cost Functions
The implicit form of the production frontier function is specified as follows:
$\mathbf{lnY_i = f\ (X_i\ \beta)\ e(V_i - \mu_i)}$.....(ii)

Where;

i: 1,2,3,….n farms
$\mathbf{Y_i}$ = Production of the i^{th} firm
$\mathbf{X_i}$ = k × I vector of input quantities of the i^{th} firm

$\boldsymbol{\beta}$ = Vector of unknown parameters

$\mathbf{Y_i}$ = Random variables which are assumed to be (N (0, σV^2)) and independent of μ_i

$\boldsymbol{\mu_i}$ = Non-negative random variables which are assumed

The Cobb-Douglas form of the frontier adopted for this research is written in explicit form as follows:

Cobb-Douglas frontier production function

$$\mathbf{lnY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_5 lnX_5 + V_i - \mu_i} \quad \text{.....(iii)}$$

Where
$\mathbf{Y_i}$ = Output
$\mathbf{X_1}$ = Number of heads
$\mathbf{X_2}$ = Feeds
$\mathbf{X_3}$ = Vaccines
$\mathbf{X_4}$ = Labour in Man day
$\mathbf{X_5}$ = Capital
$\mathbf{X_6}$ = Loan
$\mathbf{V_i}$ = Random error due to stochastic noise.

$\boldsymbol{\mu}$ = Random error (technical inefficiency).

$\mathbf{(V_{ij} - \mu_{ij})}$ = error term.

$\boldsymbol{\beta_0}$ = Intercept

$\boldsymbol{\beta_1}$, $\boldsymbol{\beta_2}$, $\boldsymbol{\beta_3}$, $\boldsymbol{\beta_4}$ and $\boldsymbol{\beta_5}$ are production function parameters to be estimated.

Therefore the inefficiency is express as;
Inefficiency Model

Therefore the inefficiency is express as;
$$\mathbf{\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7} \quad \text{.....(iv)}$$
Where,
μi = Inefficiency effect
$\mathbf{Z_1}$= Age (years)
$\mathbf{Z_2}$= Household size
$\mathbf{Z_3}$= Educational level (years)
$\mathbf{Z_4}$= Membership of cooperative/ADP rated 1 if household head was a member and 0 if otherwise
$\mathbf{Z_5}$= Sex (male = 1, female = 2)
$\mathbf{Z_6}$= Farming experience
$\mathbf{Z_7}$= Remittance (Naira)
$\boldsymbol{\delta_1}$, $\boldsymbol{\delta_2}$, $\boldsymbol{\delta_3}$, $\boldsymbol{\delta_4}$, $\boldsymbol{\delta_5}$ **and** $\boldsymbol{\delta_6}$ are model of inefficiency parameters to be estimated with the variance parameters $\boldsymbol{\delta^2}$ and $\boldsymbol{\gamma}$.

The sigma square (δ^2) and the gamma (γ) coefficients are the analytical statistics that prove the relevance of stochastic production frontier function used and the correctness of the assumption made on the distribution form of the error term. The estimates of all the parameters of the stochastic frontier production function and the inefficiency model were obtained at the same time using the Program FRONTIER version 4.1 (Coelli, 1996).

V_i is the random variability in the production that cannot be predisposed by the farmer. V_is are understood to be independent and identically distributed random errors having normal N~ (0, ∂v^2) distribution and independent of μ.

μ: Deviation from the maximum potential output ascribed to technical inefficiency. The μ_i assumed to be non-negative truncation of the half-normal distribution N ~ (μ, $\partial\mu^2$). In the concept of stochastic frontier production function, the technical efficiency (defined as the proportion of observed output to the equivalent frontier output trained on the levels of input used) of the individual farmer, modelled for the study is given as:

$$\mathbf{TE_i} = \frac{\mathbf{Y_i}}{\mathbf{Y^*}} = \frac{\mathbf{f(X_i;\beta)exp(V_i-\mu_i)}}{\mathbf{f(X_i;\beta)\,exp(V)}} = \mathbf{exp(-\mu i)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(v)}$$

Where;
TE = Technical efficiency, ranges from 0 and 1.
Y_i = Observed output from farm
Y^* = Frontier output

RESULTS AND DISCUSSION

Technical efficiencies of NAIC beneficiaries and non-beneficiaries in Kwara State

Table 1: Technical efficiencies of NAIC beneficiaries and non-beneficiaries

Efficiency Range	Beneficiaries n(%)	Non-Beneficiaries n(%)
≤0.40	0(0.0)	26(32.5)
0.41 - 0.60	0(0.0)	31(38.8)
0.61 - 0.80	18(22.5)	10(12.5)
0.81+	62(77.5)	13(16.3)
Minimum	0.64	0.23
Maximum	1.00	1.00
Mean	0.87	0.54

Note: numbers in parentheses are in percentage;
Source: Field Survey.

Majority (77.5%) of beneficiaries of NAIC have technical efficiency score ranging from 0.81 and above, while 22.5% of the livestock farmers have between 0.61 – 0.80 technical efficiency score. The mean technical efficiency score of the beneficiaries is 0.87 with a minimum value of 0.64 and a maximum of 1.0. Thus, there is still potential for increasing output at the given level of inputs being used. From the findings of Kareem et. al., (2008) majority (greater than 56%) of the Livestock farmers have technical efficiency score ranging from 0.8 – 0.9. Also majority of non-beneficiaries 38.8% have technical efficiency score ranging from 0.41 – 0.60, 32.5% have technical efficiency score ranging from 0.21 – 0.40, 12.5% have technical efficiency score ranging from 0.61 – 0.80 while the remaining 16.3% have technical efficiency above 0.80. The mean efficiency score of the non-beneficiaries is 0.54 with a minimum value of 0.23 and a maximum value of 1.00. The mean efficiency score still show some inefficiency in livestock farming in Kwara State.

Comparison of the Technical Efficiency and Output of Beneficiaries and Non-Beneficiaries.

The comparison of the technical efficiency and the output of beneficiaries and non-beneficiaries is presented in Table 2.

Table 2: The comparison of the technical efficiency and the output of beneficiaries and non-beneficiaries

Variable	Mean		Diff	t-value
	Control	Treated		
Profit	180035.90	68332.26	111703.70	4.61**
Technical efficiency(TE)	0.87	0.54	0.33	12.93**
Output	6555.15	3732.19	2822.96	2.23**

Note: ** represent significance at 5% (Source: Field Survey).

The result from the table above shows that the technical efficiency and the output level of both the beneficiaries and non-beneficiaries. The technical efficiency were significant at 5% of those that are beneficiaries compared to non-beneficiaries while their respective output in Kg were also significant at 5%. The result from the table implies that those that are beneficiaries of NAIC have higher profit than those that are not beneficiaries and also looking at their efficiency levels; the beneficiaries are more efficient than those that are non-beneficiaries. This result also goes in line with (Falola, 2015) who worked on the impact of agricultural programmes on small-scale crop farming: the case of growth enhancement scheme in Kwara state, Nigeria. The result also agreed with Kara et al., (2015) on the comparative economic analysis of beneficiaries and non-beneficiaries of fadama II project in Sardauna Local Government Area of Taraba State, Nigeria.

Determine the Levels of Production Efficiency of the Beneficiaries and Non-Beneficiaries

The result of the maximum likelihood estimates of the production frontier for the beneficiaries and non-beneficiaries of NAIC in Kwara state are presented in the table below.

The positive coefficient for Beneficiaries and Non-beneficiaries indicated that increasing those variables by one percent either individually or collectively holding other variables constant, would lead to increase in the output, respectively. The negative coefficient implies that an increase in any of the variables by one percent, holding others constant, would reduce in the output by one percent.

Table 3: Maximum Likelihood Estimates of the production frontier for the Beneficiary and Non-Beneficiary of NAIC in Kwara state

Variable	P	Beneficiaries Coefficient	Non-beneficiaries Coefficient
Efficiency model			
Constant	β_0	2.7782**(24.1042)	3.7445**(26.9909)
No of heads	β_1	0.0001**(6.9887)	0.002**(8.0915)
Feeds	β_2	0.00005**(3.0491)	0.00004**(3.6053)
Vaccines	β_3	0.0605**(4.3417)	-0.0207(-1.9517)
Labour	β_4	0.0051(0.1734)	0.0212(0.7120)
Capital	β_5	0.000006(0.0245)	-0.000006(-1.5474)
Loan	β_6	0.00002**(6.2537)	0.00007**(4.4379)
Inefficiency model			
Constant	δ_0	0.4606**(4.0052)	0.8314**(2.8248)
Age	δ_1	-0.0038**(-2.3691)	0.0005(0.0903)
Household size	δ_2	0.0028(0.5453)	-0.0357(-1.5035)
Educational Status	δ_3	0.0010(0.3258)	0.0218**(2.3713)
Membership of Cooperative/ADP	δ_4	0.0459(1.6417)	-0.3483**(-3.4039)
Sex	δ_5	0.0193(0.5920)	0.1355(1.0746)
Farming Experience	δ_6	-0.0262**(-4.0265)	-0.0136**(-2.0977)
Remittance	δ_7	0.00001**(2.0691)	0.000005(0.4477)
Sigma square	δ^2	0.0126**(6.3872)	0.1159**(4.8699)
Gamma	Γ	0.0768**(3.4430)	0.9999**(22.8218)
Log-likelihood ratio		0.0062	-15.9391
Log-likelihood test		0.0017	30.3132

Note: ** represent significance at 5%, The values in parenthesis represent t-values.
Source: Field Survey.

As shown in the Table 3 four variables- number of heads, feeds, vaccines and loans- were significant in determining the output of the beneficiaries and non-beneficiaries. The coefficient of Number per head was positive and very highly significant at 5%, implying that it increases the beneficiaries and non-

beneficiaries output by about 0.0001% and 0.002% respectively. The coefficient of feed was also positive and significant at 5%. This means that a unit increase in the feed fed to the livestock by both the beneficiaries and non-beneficiaries had the tendency of increasing their output by 0.00005% and 0.00004% respectively. This means that all the resources have been efficiently utilized by the farmers.

The coefficient of vaccines was also positive and significant at 5% for the beneficiaries while the coefficient of vaccines for the non-beneficiaries was negatively significant at 10% which implies that the vaccines used by both the beneficiaries and non-beneficiaries had the tendency of increasing their output by 6.5% and 2.1% respectively.

The coefficient of loan was positive for both the beneficiaries and non-beneficiaries and was significant at 5% which implies that the loans obtained by the beneficiaries and non-beneficiaries had tendency of increasing their output by 0.00002% and 0.00007% respectively and also implies that the loans acquired were efficiently used.

The table further shows that age, farming experience and remittance were the significant variables influencing technical efficiency of the beneficiaries while the significant variables influencing technical efficiency of the non-beneficiaries were educational level, membership of cooperative/ADP and farming experience. The coefficient of farming experience for both beneficiaries and non-beneficiaries was significant at 5% respectively and positively related to the technical efficiency. This implies that the more years an individual has been in farming, the more the technical efficiency are likely to be vice versa. This could result from the fact that those who have much experience are much likely to have acquired relevant skills to have could improve their technical efficiency better than the experienced ones. This conforms to a priori belief and is in line with some previous findings (Amos, 2007, Owolabi & Adeola 2011 and Aung 2012).

Also, the coefficient of Age was also significant at 5% for the beneficiaries while it is not in the case of non-beneficiaries. The coefficient suggests that a unit increase in the age of the non- beneficiaries had the tendency of increasing the technical efficiency by 0.38%. However, the coefficient of the Age of the household heads of the non-beneficiaries was negative though it was not significant. This might result from the fact that aged farmers are likely less active and innovative to labour as such not necessarily be technically efficient (Ajibefun & Aderinola, 2004; Ali, Imad & Yousif, 2012).

The coefficient of the membership of Cooperative/ADP was not significant for the beneficiaries but significant at 5% for non-beneficiaries. This implies that membership of cooperative/ADP has positive influence on the non-beneficiaries output and therefore implies that as the farmers are becoming members of cooperative/ADP, it has the tendency of increasing their technical efficiency by 3.5%. It is noteworthy that despite the fact that the membership of cooperative/ADP was not significant in influencing the technical efficiency of the beneficiaries but has positively coefficient.

Also, the coefficient of the remittance was significant at 5% for the beneficiaries and has tendency to increase the technical efficiency of the beneficiaries by 0.00001% which implies that the remittance gotten by the beneficiaries was efficiently utilized. On the contrary, remittance of the non-beneficiaries was not significant but has positive relationship with technical efficiency by increasing the technical efficiency of the non-beneficiaries.

Constraints Encountered in the Study Area

Major constraints encountered by the beneficiaries in the study area includes; the fear that their claims may not be paid as well as the attitude of NAIC towards the farmers during the period of disasters, strict insurance policy with the weight score of 377, 336 and 326 respectively. Other major constraints indicated by the beneficiaries were; ignorant about the benefits of agricultural insurance, high premium rate, access to credit, compensation paid do not cover loss and late payment of compensation.

Table 5: Distribution of the livestock farmers according to the constraints encountered in the study area

Constraints encountered	Beneficiaries 80(%)						
	VS	S	MS	NS	ID	MS	WS
Strict Ins. Policy	21(26.3)	45(56.3)	13(16.3)	1(1.3)	0(0.0)	2.80	326
High Premium Rate	5(6.3)	36(45.0)	32(44.0)	6(7.5)	1(1.3)	2.44	278
Access to Credit	0(0.0)	28(35.0)	44(55.0)	4(5.0)	4(5.0)	1.93	256
Attitude of NAIC	24(30.0)	48(60.0)	8(10.0)	0(0.0)	0(0.0)	2.89	336
Ign. about benefit of agric insurance	12(15.0)	28(35.0)	35(43.8)	3(3.8)	2(2.5)	2.53	285
Fear that claims may not be paid	58(72.5)	21(26.3)	1(1.3)	0(0.0)	0(0.0)	3.01	377
Compensation paid do not cover loss	2(2.5)	21(26.3)	43(53.8)	12(15.0)	2(2.5)	1.80	249
Late payment of compensation	0(0.0)	24(26.3)	38(47.5)	11(13.8)	7(8.8)	1.29	239

Note: numbers in parentheses are in percentage; Source: Field Survey

x(y); **x** = frequency, **y** = percentage **MS** = Mean, **WS** = Weight Score

VS = Very severe, **S** = Severe, **MS** = Moderately severe, **NS** = Not severe,

ID = Indifferent.

Conclusion

Levels of efficiency differ between the two groups of the farmers. The mean technical efficiency of the beneficiaries and non-beneficiaries were 0.87 and 0.54 respectively.

The variables that determine the output of the beneficiaries and non-beneficiaries were number of heads, feeds, vaccines and loans. Also, the significant variables influencing the technical efficiency of the beneficiaries were Age, farming experience and remittance while significant variable influencing the technical efficiency of non-beneficiaries were educational level, membership of cooperative/ADP and farming experience respectively.

The constraints encountered by most of the beneficiaries in the study area includes: drought, variation in yield, lack of access to input, disease, and pests etc while that of non-beneficiaries was disease, pest, lack of access to input, drought and variation in yield respectively.

Major constraints encountered by the beneficiaries in the study area includes; the fear that their claims may not be paid as well as the attitude of NAIC towards the farmers during the period of disasters, strict insurance policy with the weight score of 377, 336 and 326 respectively.

The findings of this study revealed that; the insured farmers are more efficient compared to those that were not insured. This study has also revealed that agricultural insurance had some positive impact on the activities of the farmers (beneficiaries).

Based on the findings, therefore, it is recommended that the insurance workforce should develop strategies that will encourage much participation in the insurance program and also create more awareness among farming households. This will motivate more farmers to partake in the program. However, procedures and conditions involved in registering farmers should be reduced so that more people will be encouraged to take agricultural insurance. Government should focus on improving the output of the participants through provision of some inputs needed and also help to subsidize some of these inputs. Also, more skilled farmers should be encouraged to participate in the program.
Also, agricultural insurance corporations should provide insurance to farmers at affordable rates as to encourage them to obtain it.

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