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Economic Effects of Malaria Infection on Farmers' Income in Kogi Eastern Agricultural Zones

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Authors' contributions

This work was carried out in collaboration among all authors. Author FOO designed the study, performed the statistical analysis. Author SIA wrote the protocol and managed the analyses of the study. Author YEA wrote the first draft of the manuscript. Author AJO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study assessed the effect of malaria infection on farm households in the eastern Agricultural zones of Kogi State. Specifically, the study described the socioeconomic characteristics of the farmers, determined the relationship between farmer's output and malaria factors and compared the output valued in naira of the infected and non-infected farmers in the area. Using proportionate and random sampling techniques, 120 infected and 120 non-infected farmers were selected for the study. Structured questionnaire was used to collect the required information. Data obtained were analyzed using descriptive, Ordinary Least Square (OLS) and z-test statistics. Result from the study showed that 69.9% of the respondents were male with an average age of 40 years, married with a mean household size of 7 persons. Farmers in the area had a mean farming experience of 18 years and operated on an average farm size of 1.6 hectares. The mean output valued in naira was N53, 334 and N66, 250 for the infected and non-infected farmers, respectively. Result of the OLS analysis showed that age (β=0.176), household size (β=0.463), transport cost (β=-0.236), days of incapacitation (β=-0.455), and treatment cost (β=-0.126), showed significant relationship with the value of farmer's output at 1%, 1%, 1%, 1% and 5% levels of risk respectively. In addition, z-test statistics indicated a significant difference (N12, 916) at 5% level of risk between the output of the

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infected and non-infected farmers. Hence, the study showed that malaria affected farmers and their families because of loss of man days and the expenditure that it inflicted on them which resulted in a substantial output loss in last cropping season. The study recommends establishment of hospital and clinics in many settlements to reduce the distance travelled for medication, treatment subsidy and free drugs should be made available for poor people in the society.

Keywords: Economics; effects; malaria; infection; farmers; income.

1. INTRODUCTION

Health is required for better quality of life, social and economic development of any country. It implies a state of social, mental, and physical well-being and not necessarily the absence of disease or infirmity [1]. Basically, it is known that a sick population is a burden to a nation because substantial proportion of resources that could have gone for investments would be diverted to combating preventive diseases and care [2]. The global impact of malaria on human health, productivity, and general well-being is profound, and Africa has been particularly hard hit. In 2006, more than 90 percent of deaths from malaria occurred in Africa, where 45 of the 53 countries are endemic for the disease [3]. [4] Further maintained that heath risk and particularly malaria has some debilitating effects on the output and income through cost of health care, man days of labor lost to malaria medication and physical weakness.

There are multiple channels by which malaria impedes development, including effects on fertility, population growth, saving and investment, worker productivity, absenteeism, premature mortality, and medical costs [5]. [6] Maintained that malaria's effect on smallholder farmers can be devastating. Brief period of illness that delays planting or coincides with the harvest may result in catastrophic economic effects. Malaria transmission generally coincides with the planting and harvesting seasons, making the illness's impact particularly damaging. Farm households may also withdraw savings, sell productive assets, or borrow money to pay for treatments, a farmer may not be able to cultivate as much land and engage in intensive farming practices. He may then plant less labor-intensive crops and change cropping patterns, perhaps raising a few crops with low return. Fewer improvements may be made to farms, further decreasing their productivity even when illness is not an issue [7].The fight against malaria is far from over since the population at risk continues to be significant (nearly 300 million clinical cases in the world), [1].

According to [8] farmers´ health status has a significant effect on their capacity to increase output, because ill health could impact negatively on the number of hours spent on farm and amount of income earned. Health risk and particularly malaria, has some debilitating effects on the output and income through cost of health care, man days of labor lost to malaria medication and physical weakness. [6] Pointed out that Malaria leads to loss of agricultural labor due to illness and death, wastage of family members' time and energy in caring for malaria patients and grieving for people killed by malaria. Malaria also results into loss of agricultural knowledge and skills, especially if it kills an experienced farmer.

Failure to wipe out and prevent resurgence, can translate into loss of majority of work force needed for efficient agricultural production in the economy. [9] Established a positive relationship between the health status and productivity of workers. The consequences of malaria include emotional distress caused by illness and sometimes death of the affected individuals. Critical need to care for those infected and to find ways of replacing their contributions to the household and the community are also associated with this as affirmed by [10].

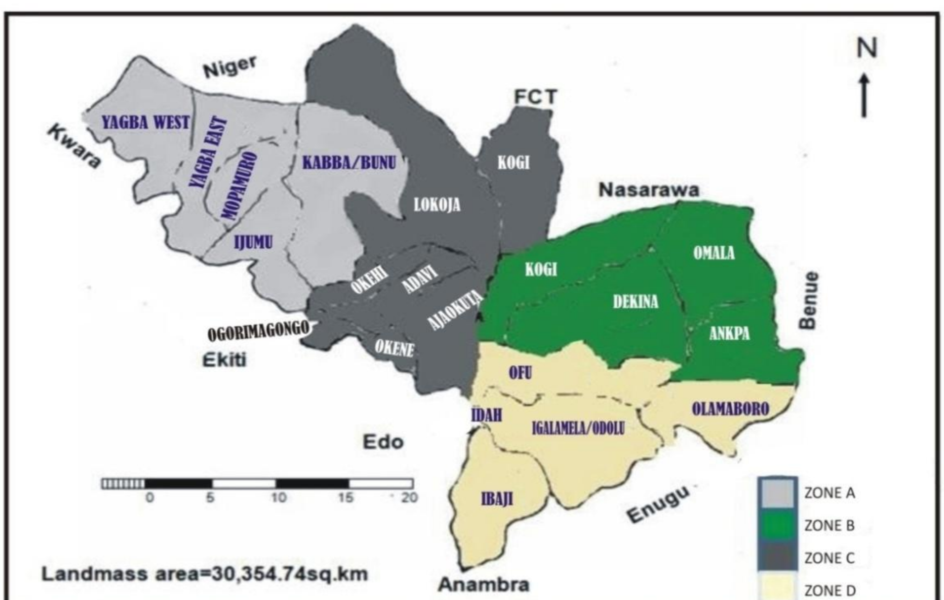
Though malaria is endemic in Nigeria, facilities to use in combating it are inadequate. Trained medical personnel such as doctors, nurses and radiographers are in short supply. Hospitals are inadequate. Many farmers travel several kilometers before they can reach the nearest government hospital. Malaria drugs are in short supply and are very costly beyond the affordability of farmers. In most rural areas, quacks have taken over the functions of trained and licensed medical personnel. Studies that should have brought medical situation in the rural areas to the glee of the policy makers are inadequate. Most medical studies have concentrated in the urban areas and among the educated elites because of the easy terrain of the areas and the understanding of the urban dwellers. In the light of this, this study is to fill the gap and designed to achieve the following objectives: (i) describe the socioeconomic characteristics of the farmers in the study area, (ii) determine the effects of malaria infection on the output of rural households and (iii) compare the output of malaria infected and non-infected farmers in the area.

2. METHODS

The study was carried out in Eastern Agricultural Zones of Kogi State, Nigeria. According to Kogi State Agricultural Development Project [11], Kogi state is divided into four Agricultural zones namely: Zone A (Kabba/Bunu, Ijumu, Mopa Amuro, yagba East and Yagba West LGAs), Zone B (Ankpa, Bassa, Dekina and Omala LGAs), Zone C (Kogi, Lokoja, Ajaokuta, Adavi, Okehi and Okene LGAs) and Zone D (Olamaboro, Ofu, Igalamela/Odolu, Idah and Ibaji LGAs), with their zonal headquarters in Aiyetero-Gbede, Anyigba, Kotonkarfe and Alloma respectively. Geographically, Kogi East is located between latitudes 6^{o} 30'N and 8^{o} 50'N and longitudes 5^{o}51'E and 8^{o}00'E. It has a population of 115,100 people: 58,864 males and 56,236 females [12]. It shares common boundaries with Nassarawa State to the North, Benue State to the East, Edo state to the West and to the South by Enugu and Anambra states [13].

The study covered all ADP registered farmers in Agricultural Zones B and D in Kogi State and focused on farmers who had reported malaria cases and were diagnosed (infected) and farmers who had not reported any malaria case (non-infected) in the last cropping season. A purposive sample of two Local Government Areas (LGAs) was selected from each of the two zones because of their riverine terrain. In this wise, Bassa and Omala LGAs which are at the bank of river Benue were selected to represent zone B while Idah and Ibaji LGAs which are at the bank of river Niger were selected to represent zone D. Then two settlements were randomly selected from each LGA making eight settlements.

Based on the sampling frame of farmers in the LGAs obtained from KSADP, the sample size for respondents for each LGA was estimated. A total of 47, 397 registered farmers were obtained from ADP and these were distributed into four LGAs as follows; Bassa (9, 397 farmers); Omala (11, 500 farmers); Idah (3, 500 farmers) and Ibaji (25, 000 farmers). A proportionate sample of farmers was obtained for each LGA based on this distribution and this was 48, 58, 18 and 116 farmers for Bassa, Omala, Idah and Ibaji respectively, making the 240 respondents that were randomly selected for the study.



Source: GIS Lab. 2010

Fig. 1. Map of Kogi State, Nigeria showing the four Agricultural Zones
Source: GIS Lab Kogi State University, 2010

The proportionate sampling model is specified as;

$$nh = Nh(n/N) \quad (1)$$

Where;

n = sample size, n_h = number of farmers selected from each LGA, N = Total number of farmers from the selected LGAs, Nh = total number of farmers in each LGA.

Primary data were used for the study. These were collected using a well-structured questionnaire. Information obtained from the respondents through the questionnaire were on their socioeconomic characteristics and effects of malaria infection on farmers' output. Information about infected farmers was obtained from General Hospitals and Health centres in the localities. Name and addresses of those who came for treatment were obtained under confidential cover and were traced to their places.

2.1 Method of Data Analysis

Objective one was achieved using descriptive statistics. Ordinary Least Squares (OLS) multiple regression analysis was used to achieved objective 2 while objective 3 was attained using Z-test statistic to compare the output of malaria infected farmers and non-infected farmers.

2.1.1 Model specification

The OLS model adopted in the study is as specified below:

$$Y_i = f(X_{is}) \quad (2)$$

Where, Y = dependent variables and Xis are the independent variables.

The explicit form of the model is presented in the equation below:

Explicitly, the regression model expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \mu \quad (3)$$

Where,

Y = outputs (naira)
X_1 = Age
X_2 = Household size
X_3 = Education
X_4 = transportation cost
X_5 = cost of malaria prevention
X_6 = days of incapacitation due to malaria attack and care giving (man days)
X_7 = cost of malaria treatment
β_0, β_1..... β_7 are the regressionparameters (estimated coefficients)
μ is the disturbance term.

The Z-test statistic used is stated as:

$$Z = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{S^2{}_1 S^2{}_2}} \quad n_1 + n_2 \quad (4)$$

Where,

$\overline{X_1}$ = mean output of infected farmers (N)
$\overline{X2}$ = mean output of non infected farmers (N)
S_1 = output standard deviation of infected farmers
S_2 = output standard deviation of non infected farmers
n_1= sample size of infected farmers
n_2 = sample size of non-infected farmers

Decision rule

If Z-computed is greater than Z-tabulated at 1%, it shows a significant different in the output of the two categories of farmers, but if otherwise, there is no significant different.

2.1.2 Functional form specification

The relationship between the endogenous and each of the exogenous variables was examined using two (2) functional forms: semi-log and Double-log.

Semi-log: $Y = \beta_0 + \beta_1 \log X1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_6 + \beta_7 \log X_7 + \mu$ (5)

Double-log: $\text{Log}y = \beta_0 + \beta_1 \log X1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_6 + \beta_7 \log X_7 + \mu$ (6)

The lead equation called the best linear unbiased estimate (BLUE) functional form was chosen based on econometric considerations such as magnitude of the independent variables, the coefficient of determination (R^2) and magnitude of the error term as well as statistical significance of the coefficient of independent variables.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics of the Respondents

3.1.1 Distribution of the respondents according to their sex, age and family size

Results on the socioeconomic characteristics of infected and uninfected farmers are presented in Table 1. The male farmers' dominance is in line with African tradition were men are household heads. The mean age of the infected and uninfected farmers was 33 years and 40 years respectively, which is an indication that most of the farming population are relatively young and active. By implication, they could be innovative and dynamic, with more strength to carry out agricultural work which is physically demanding as stated by [14]. The mean household sizes for the infected and non-infected farmers were 8 and 7 persons, respectively. Large household can serve as a reservoir of labor especially for members who do not go to school. [15] Reported that household size had implication for labor availability and could influence the likelihood of innovation adoption. On the negative side as reported by [16] families with large household size usually have low income which in turn increase their poverty status, and by implication predisposed to malaria infection.

3.1.2 Distribution of the respondents based on their educational status, farming experience, farm size and farm income

The mean educational level for infected and non-infected was 5 years and 5 years respectively. Educational status of an individual plays a significant role when it comes to their health status as the most educated farmers are well equipped with both preventive and curative strategies when it comes to ailment. This result supports the findings of [17], who with data from the Malawi 2000 DHS, revealed that women with lower levels of education were more likely to have fever than women with higher levels of education. The result further showed an average year of farming experience of 18 years and 19 years for infected and non-infected farmers respectively with a pooled mean farm size of 1.5 hectares. This is an indication that the farmers were experienced in farming activities and operates on a small scale. Perhaps, household heads with large farm size may be more susceptible to malaria illness because of the drudgery nature of crop farming in the state, which could lead to a lot of emotional stress, thereby predisposing them to malaria [18]. The average output valued in naira was N53, 334 and N66, 250 for the infected and non-infected farmers, respectively. The monthly income of infected and non-infected households was N634.9 and N788 respectively; this is an indication that the non-infected farmers were better off. Since these figures are less than the national average of N834.02 [19] and the average of N814.24 found for agricultural workers, it could be inferred that in terms of agricultural production, farmers in the area are sinking deeper into poverty [20].

3.2 Effects of Malaria Infection on the Output of Rural Households

Estimates of the Ordinary Least Square (OLS) multiple regression results of the effects of malaria infection on farmers' output are presented in Table 2.

The semi-log functional form was chosen as the lead equation based on the magnitude of R^2, the significance of the overall relationship as judged by f-ratio and the individual regression coefficients. The R^2 was 0.679 which means that the factors included in the model explained 68% of the variation in famers output.

Educations (β = -0.014), transport cost (β = -0.236), days of incapacitation (β = -0.455) and treatment cost (β = -0.126) had negative relationship with farmers' output, while age (β = 0.176), household size (β = 0.463) and prevention cost (β = 0.083) had positive relationship with farmers' output.

The coefficient of age which is 0.176 was positive and significant at 1% level of risk. This shows that age has a direct relationship with the farmers' output. Farmers output increases with age up to a certain level. This is because age has a great influence in instilling a deep sense of dedication and responsibilities in individuals. Experience is also acquired with age. Therefore, age and experience can trigger output. Individuals become less predisposed to malaria illness as they grow older ([21]; [22]). The speed with which a population acquires functional immunity to the severe consequences of *P. falciparium* infection depends on the frequency of parasite exposure from birth as measured by the intensity of parasite transition in a given locality [23].

The coefficient of household size is 0.463 and significant at 1% level of risk. This implies that increase in the household size of the farmers may lead to increase in their productivity and output. This is because even if some members are infected with malaria or any illness others are still available to work. Also, labor is available to clear surrounding bushes and houses are safeguards against breeding of malaria

Table 1. Distribution of respondents according to socioeconomic characteristics

Variables	Infected			Uninfected			Pooled		
	Freq.	%	Mean	Freq.	%	Mean	Freq.	%	Mean
Sex									
Male	81	67.5		86	71.7		167	69.6	
Female	39	32.5		34	28.3		73	30.4	
Total	120	100		120	100		240	100	
Age (Years)									
21-30	19	15.8		26	21.7		45	18.8	
31-40	42	35.0		46	38.3		88	36.7	
41-50	36	30.0	33yrs	28	23.3	40yrs	64	26.7	40yrs
51-60	17	14.2		14	11.7		31	12.9	
Above 60	06	5.0		6	5.0		12	5.0	
Total	120	100		120	100		240	100	
Household size									
1-5	29	24.2		41	34.2		70	29.2	
6-10	75	62.5	7.5	64	53.3	7	139	57.9	7
11-15	15	12.5		11	9.2		26	10.8	
Above 15	01	0.8		04	3.3		05	2.1	
Total	120	100		120	100		240	100	
Years spent schooling									
0 (No formal education)	70	58.3		30	25.0		100	41.7	
1-6	31	25.8	5yrs	48	40.0	5yrs	79	32.9	5yrs
7-12	12	10.0		25	28.8		37	15.4	
Above 12	07	5.8		17	14.2		24	10.0	
Total	120	100		120	100		240	100	
Farming experience(Yrs)									
1-10	34	28.3		25	20.8		59	24.6	
11-20	36	30.0	18yrs	49	40.8	19yrs	85	35.4	19yrs
21-30	31	25.8		29	24.2		60	25.0	
Above 30	19	15.8		17	14.2		36	15.0	
Total	120	100		120	100		240	100	
Farm size(Ha)									
≤ 1.0	60	50.0		13	10.8		73	30.4	
1.1-2.0	39	32.5	1.5ha	07	5.8	1.6ha	46	19.2	1.6ha
2.1-3.0	09	7.5		46	38.3		55	22.9	
> 3.0	12	10.0		54	45.0		66	27.5	
Total	120	100		120	100		240	100	
Output (N)									
≤50,000	40	33.3		22	18.3		62	25.8	
50,001-100,000	52	43.3	53,334	10	8.8	66,250	62	25.8	59,792
100,001-150,000	15	12.5		15	12.5		30	12.5	
150,001-200,000	06	5.0		08	6.7		14	5.8	
Above 200,000	07	5.8		10	54.2		72	30.0	
Total	120	100		120	100		240	100	

Source: Field survey data, No. of Obs. = 240

Table 2. Regression results of effects of malaria infection on the Output (₦) of rural households in the eastern agricultural zones of Kogi State

Explanatory variables	Semi log coefficients	Double log coefficients
Constant (K)	-91931.780 (-3.248)***	3.959 (11.944)***
Age (X_1)	0.179 (3.445)***	0.030 (0.479)
Household size (X_2)	0.463 (8.911)***	0.387 (5.972)
Education (X_3)	-0.014 (-0.237)	0.022 (-0.293)
Transport cost (X_4)	-0.236 (-5.668)***	-0.133 (-2.550)***
Prevention cost (X_5)	0.083 (0.812)	0.192 (1.508)***
Days of incapacitation (X_6)	-0.455 (-6.709)***	-0.499 (-5.896)***
Treatment cost (X_7)	-0.126 (-2.327)**	-0.195 (-2.886)***
R^2	0.679	0.500
f-ratio	70.107	33.141
prob f	0000	0000
No of obs	120	120

Source: Computed from Field Survey Data, No. of Obs. = 120
**** = significant at 1%, ** = significant at 5%*
Figures in parenthesis are the respective t-ratios

parasites. On this, [17] reported that large household size and household labor may be less likely to predispose household heads to malaria illness, since household members often supply the needed labor force for sanitary and farm work in traditional agricultural setting.

The coefficient of transport cost is -0.236 and significant at 1% level of risk. This implies that for every N1 increase in the transport fare paid to reach the medical centre there will be a 24% decline in farmers' output in malaria infected households. The cost incurred in terms of transportation fares from one's location to another for the purpose of receiving medical treatment depends on the distance. The fare incurred and time lost in travelling to the source of treatment constitutes the opportunity cost of treatment. The results suggest that the opportunity cost of receiving malaria treatment was the decline in crop output (24%). This finding is in consonant with the finding of [24] who reported that the cost incurred to reach sources of malaria treatment may be further compounded by the fact that often times, malaria infected individuals do not go to hospital alone, but in company of care-givers, which may further increase the economic burden and push households further into poverty.

The coefficient of days of incapacitation is -0.455 and significant at 1% level of risk. The inverse relationship implies that farmers' output would decrease by 46% with every unit increase in days of incapacitation. Days of incapacitation constitute actual labor or man days lost from carrying out normal activities, like farming as a result of malaria disease. This has implication for increased poverty among households in malaria endemic agricultural communities, which may give rise to a vicious circle of low crop output - low agricultural investment - high poverty range. Similarly, [17] reported in their investigation into the effects of malaria indices on crop output in the rural communities of Yobe State, that during the period of malaria infection, a typical farmer may stop work partially or completely due to incapacity arising from malaria attack. Accordingly, labor availability and productivity may suffer a retard. Under severe malaria attack, labor may not be available on the farm at all during the period of incapacitation, while in a situation of mild malaria attack, the intensity or productivity of labor, which is measured by work done per unit time, may be reduced. The loss of workdays because of malaria illness had accounted for the decline in farm outputs [25].

Table 3. Z-Test Statistics for the Comparison of Output among Infected and Non-infected Farmers in the Eastern Agricultural Zones of Kogi state

Test parameter	Mean output (₦)	N	Standard Deviation	Z- cal	Z- tab	Remark
Non-infected	66,250	120	61050.24	427.25	2.58	***
Infected	53,334	120	49314.13			

Source: Computed from Field Survey Data
*** Significant at 5%*

The coefficient of treatment cost is -0.126 and significant at 5% level of risk. The inverse relationshipimplies that farmers' output would decrease by 13% with every naira increase in cost of malaria treatment.This means less money will be available for households to invest in farming. In other words, cost of treating malaria among farmers tends to be economic burden and have widely reduces farmers' efficiency. This is in agreement with [7] who observed that the cost of treating and preventing malaria, could lead households to reduce farm area, planting of less labor intensive crops, changing cropping pattern, adoption of labor-scarce innovations that may be less productive. [24] Further observed that expenditure on malaria, like any other treatment costs would reduce funds to hire casual laborers and to buy inputs like fertilizers and improved seeds.

3.3 Output Comparison among Malaria Infected and Non-Infected Farmers

The output of malaria infected farmers and the output of farmers that were not infected with malaria compared with the use of z-test statistic. The result is presented in Table 3.

The result presented in Table 3 shows that the calculated z value of 33.04 is greater than the critical z-value of 1.65. This means that there is significant difference (N12, 916) in the output of the malaria infected and non-infected farmers in the last cropping season in the area. This difference in output is the productivity loss due to malaria influence, resulting from labor hours or man-days lost by farmers, due to malaria attack and care giving to infected family members. It could be inferred that malaria must have created significant negative effect on the output and economic well-being of farmers, in the eastern agricultural zones of Kogi state. This result is in agreement with the findings of [26], [2] and [4] who reported that malaria could significantly affect productivity and economic growth in Africa. In addition, malaria affects both the body and income of the victim.

4. CONCLUSION AND RECOMMENDATION

Malaria affected the farmers and their families because of loss of man days and the expenditure that it inflicted on them. In the same way, farmers' output was greatly reduced by expenses on medication and transportation cost to health centers. Absenteeism from farms because of farmer's infection and the care of infected ones, also contributed to reduce farmers output and income. There was clear difference in the performance of household with malaria and those without malaria. Based on these findings, the following recommendations are made:

1. Health Centres, Hospital and Clinics should be established in many settlements so that people do not travel long distances to get medication.
2. Treatment subsidy and free drugs should be made available for poor people in the public health system.
3. Medical personnel such as doctors, nurses and radiographers should be trained and posted to rural areas so that people can have access to them
4. Public health programmes to inform and educate on the need to prevent the infection, must be taken to all categories of people through the print and electronic media. This will go a long way to support the popular saying "prevention is better than cure"

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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