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Economic Analysis of Cocoa Production Cropping Pattern in Nigeria, West Africa

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Abstract

Cocoa is the most prominent export crop in Nigeria in terms of its production and export capacities. There is dearth of literature on the profitability of different cropping systems. This study therefore examined the profitability of the different cocoa cropping systems and the factors that affect revenue of cocoa farmers for each of the cropping systems. The study area was Nigeria and information were collected from one hundred and eighty farmers using well-structured questionnaires. Descriptive statistics, economic analysis and linear regression were used for analysis in this study. The study revealed that twenty-seven farmers practiced sole cocoa cropping, seventy-five farmers practiced cocoa/arable cropping and seventy-eight farmers practiced cocoa/tree cropping systems, respectively. The mean age of farmers in sole cocoa cropping system was 49.3 years, for cocoa/ arable cropping system the mean age was 47.8 years while for cocoa/tree cropping system the mean age of farmers was 47.2 years. For sole cocoa cropping system, the total cost (TC) was USD 7,764; the gross revenue (GR) was USD 43,774 with profit was USD 36,009. The TC for cocoa/tree cropping system in Nigeria was USD 18,003, GR was USD 124,104 and the profit was USD 106,102. Similarly for cocoa/arable cropping system, the TC was USD 16,215, GR was USD 109,849 and profit was USD 93,634. The determinants for the three cocoa cropping systems were age, gender, marital status (married), educational level (primary), cost of seedling, cost of fertilizer, cost of fungicide, cost of herbicide, labour cost for bush clearing, land preparation, weeding and planting. Cocoa/tree and cocoa/arable cropping systems were more profitable than sole cocoa cropping systems. However, cocoa/ tree cropping system was more profitable with a value of USD 106,102.

Keywo rds: Cocoa, cropping system, Nigeria, profit

INTRODUCTION

Nigeria is currently the world's fourth largest cocoa producer having recently moved from fifth largest, dislodging Ecuador from the former (FAOSTAT, 2021; The PWC, 2016). Nigeria is also the third largest exporter of cocoa beans after Ivory Coast and Ghana. The top two countries (Ivory Coast and Ghana) combined to cultivate more than half of the world's cocoa (WCF, 2013; Odijie, 2018). Cocoa is the most prominent export crop in Nigeria in terms of its production and export capacities (Abdullahi *et al*., 2021; Nwachukwu *et al.*, 2010). According to (Awoyemi & Aderinoye-Abdulwahab, 2019; Adebile & Amusan, 2011) cocoa contributes about 15% to the total Nigeria export in 1970 and its contribution to Nigeria's foreign earnings is USD 270,5 million in the first quarter of 2022 (Premium Times, 2022).

Agriculture served as Nigeria's economic backbone before oil was discovered constituting a significant portion of the GDP and up to 75% of the national economy (Victor & Onyeukwu, 2022). The export of cocoa was crucial to Nigeria's economy. Nigeria became prominence as one of the world's top exporters of cocoa by the middle of the 1950s, with exports amounting to about two hundred and eighty thousand tons. Thus, cocoa rose to become the nation's biggest export, generating almost 30% of its foreign exchange revenues (Walker, 2000). After oil was discovered in the late 1950s, the agricultural sector was ignored, and the country's population's ability to eat became heavily dependent on the importation of food crops like rice and wheat. Despite changes in the country's primary source of foreign exchange, cocoa continues to be important to old western region's populace economic life and recently made a significant contribution to the country's foreign exchange earnings. However, the discovery of commercial quantities of crude oil in Nigeria cut the cocoa boom era short, and since then, the performance of the country's agricultural sector including that of cocoa has been decreasing. According to PWC (2016), in the years 2010, 2011, 2012, 2013, and 2014, cocoa's production in Nigeria fell by 37.9%, whereas other West African nations that produce the crop saw increase in output as a result of higher input consumption and the extension of cocoa fields. Nevertheless, cocoa cultivation supported economic activity for a variety of people both inside and outside the production zone as of 2006 (Nkang *et al*., 2006).

Cocoa production is a labor-intensive process that involves a variety of skill sets and backgrounds, with each group taking up a portion of its own in the value chain. In addition, the rural population, including elderly farmers (men and women) and recent graduates, derive employment prospects from planting, maintenance, harvesting, and drying of cocoa. Similarly, government employees, national and international businessmen, and consumers all benefited from the quality control marketing processing and exporting (Nkang *et al*., 2007). Meanwhile, intense and ongoing discussion concerning the benefits and drawbacks of cocoa monocropping systems as compared to cocoa agricultural farming systems (AFS) has resulted from the deployment of these systems (Lennon *et al*., 2021). Ghana, which rose from 4th to 2nd position in 2014, has overtaken Côte d'Ivoire ranked globally as the topmost leading cocoa beans producer over the past four decades. Nigeria, however, has been struggling to maintain its fourth-place ranking in the production of cocoa since 2014.

According to Oluyole & Sanusi (2009); Nkang *et al.* (2009), there are three cocoa cropping management systems. These are sole cocoa cropping, cocoa/arable cropping and cocoa/tree cropping systems. Sole cocoa cropping system involved planting only cocoa on a plot of land in a cropping season. Cocoa/ arable cropping involves the cultivation of cocoa and arable crops such as maize, vegetables on the same piece of land during a crop- ping season. This is usually done such that the farmers have something to feed on with their families before cocoa matures. Cocoa/ tree cropping system involves the planting of cocoa and other tree crops (such as banana, plantain, rubber, oil palm, breadfruit and coconut) on the same piece of land. These management systems are practiced across all cocoa producing re- gions in Nigeria basically for land intensi- fication and food diversification. Despite the fact that some studies on cocoa affirmed that there are cocoa production systems and that cocoa production in general is profit- able, there is however dearth of information on the extent at which different cocoa pro- duction management systems affect cost and return and hence the level of profitability of each of the cropping systems. In as much

that the basic objective of a rational producer is to maximize profit and to minimize cost through efficient allocation of resources over a period of time, therefore, this particular study found it quite imperative to determine the costs and returns of cocoa production management systems in the study area. This study aimed to determine the profitability of each cocoa cropping systems. Furthermore, it aimed to determine the factors that affect the revenue of cocoa farmers for each of the cropping systems.

MATERIALS AND METHODS

Multistage sampling technique was used to select respondents for this study. The first stage, involved purposive selection of three geopolitical zones (South West, South South, and North Central) based on the volume of cocoa production in these zones. Similarly, the second stage involved purposive selection of one state each from the three geopolitical zones representing high, medium and low cocoa production states, respectively. These are Ondo state (South-west), Cross River state (South-south) and Kwara state (North-central). In each of the selected states, two local governments areas (LGAs) were randomly selected thus making a total of six LGAs selected for the study. Thirty five cocoa farmers were randomly selected in each LGA. In each state, seventy cocoa farmers were selected making a total of two hundred and ten cocoa farmers were randomly selected for the study. Finally, one hundred and eighty farmers' information were used for analysis after sorting out for missing data.

Information was collected from the farmers by using structured questionnaire. The parameters obtained from the farmers were socioeconomic characteristics (age, gender, marital status, educational level, types of land ownership, farm size, socioeconomic group membership, and type of cocoa seedling used), cost production including cocoa seedlings, fertilizer, fungicides, insecticides, herbicides, and labour cost in the last production season, such as bush clearing, land preparation, weeding, planting, agrochemical application, and harvesting, average quantity of cocoa production (kg), and price of cocoa per kg. The information collected were analyzed using descriptive statistics, economic analysis, and linear regression analysis.

(i) Economic analysis

Total Variable Costs (TVC) =
Total variable Input cost + Total labour cost

Total Fixed Cost (TFC) =
Cost of equipment and machineries

Total fixed cost/farmer =
Total fixed cost/number of farmers

Total cost = (TVC +TFC)

Gross Revenue = output x price

Gross Margin =
Gross Revenue - Total Variable Costs

Net Income =
Gross Revenue - Total Fixed Cost

Profit =
Gross Revenue - Total Cost

(ii) Linear Regression Analysis – this was used to determine the factors that affect the revenue of cocoa farmers for each of the cropping systems.

The implicit model is:

$Y_i =$

$x_1 + _1 x_2 + _2 ..... + x + e_p \; _p ...._i .....(i)$

Where: Y = Revenue from cocoa and other crops; Ei = error term

The X_is are cost of cocoa seedling, cost of fertilizer, cost of fungicide, cost of insecticide, cost of herbicide, labour cost on bush clearing, land clearing, weeding, planting,

agrochemical application, cost of harvesting, sex of farmer, educational level of farmers and age of farm (years).

The variable costs used in the cocoa farms were cost of seedling, cost of fertilizer, cost of fungicide, cost of herbicide, labour cost of bush clearing, land preparation, weeding, planting. The fixed cost used in the cocoa farms were depreciation cost of hoe, cutlass, tractor, and jute bag. All the costs were measured in USD equivalent.

RESULTS AND DISCUSSION

Socioeconomic Characteristics

Table 1 showed the socioeconomic characteristics of cocoa farmers in the study area. The table revealed that twentyseven farmers practiced sole cocoa cropping, seventy five farmers practiced cocoa/arable cropping and seventy eight farmers practiced cocoa/ tree cropping systems, respectively. The table revealed that for all the cocoa cropping systems considered in the study, majority of the farmers are in their productive years (31-60 years). Similarly, the mean age of farmers in sole cocoa cropping system was 49.3±13.4, for cocoa/arable cropping system the mean age was 47.8±13.1 years while for cocoa/tree cropping system the mean age of farmers was 47.2±12.5 years. In sole cocoa cropping system all the farmers were male while in cocoa/arable cropping 28% were female and 31% female farmers were also involved in cocoa/tree cropping. In the study women farmers were more involved in cocoa/arable and cocoa/tree cropping system as compared with sole cocoa cropping system. This may probably be that they are able to get other crops on their farm apart from cocoa which they can eat/sell to sustain their families. Majority of the farmers involved in cocoa cropping systems in this study were married.

In sole cocoa cropping system, 33.3% of the farmers had no formal education, 55.6% had secondary education while 11.1% had tertiary level of education. For cocoa/ arable cropping system, 32% of the farmers had no formal education, 36% had primary education, 28% had secondary education and 4% had tertiary education. Furthermore, in cocoa/tree cropping system 19.2% of the farmers had no formal education, 77% had primary and secondary level of education and 3.8% had tertiary education. According to Ammann *et al*. (2022) education plays a key role in the technological advancement among farmers. Majority of the cocoa farmers in this study owned the land in which they planted cocoa. Land ownership is a key factor in crop production (Austin *et al*., 2012). The other types of land ownership considered are inheritance, share cropping and rentage. Also, in sole cocoa cropping system 88.9% used hybrid cocoa seedling and 11.1% used Amelonado cocoa seedling as planting materials. In cocoa/arable cropping system 64% of the farmers used hybrid cocoa seedling, 28% used F3 Amazon while 8% used Amelonado as planting materials. Also 92.4% of the farmers who practiced cocoa/tree cropping system used hybrid and F3 Amazon type of cocoa seedling, 7.6% used Amelonado. In this study farmer who practiced cocoa/tree cropping system used more of hybrid seedlings compared to farmers that used other cropping systems. The mean farm size for sole cocoa cropping system was 8.7±8.0 ha, for cocoa/ arable crop the mean farm size was 7.3±7.0 ha and for cocoa/ tree crop it was 8.4 ±7.7 ha.

The cost and return analysis for sole cocoa cropping system represented in Table 2. The total variable cost (TVC) was USD 7,266 while the average variable cost (AVC)/farmer was USD 269. The total fixed cost (TF) was USD 498.1 and the average fixed cost (AFC)/farmer

Table 1. Socioeconomic characteristics of cocoa farmers in Nigeria

Variable	Sole cocoa Cropping (N = 27)	Cocoa/Arable cropping (N = 75)	Cocoa/Tree cropping (N = 78)	All (N =180)
Age				
30	3(11.1)	9(12)	9(11.5)	15(10.6)
31-60	24(88.9)	66(88)	69(88.5)	126(89.4)
Mean	49.3±13.4	47.8±13.1	47.2±12.5	48±13
Gender				
Male	27(100)	54(72)	54(69.2)	105(74.5)
Female	0(0)	21(28)	24 (30.8)	36(25.5)
Marital status				
Single	3(11.1)	6(8)	3(3.8)	9(6.4)
Married	24(88.9)	69(92)	75(96.2)	132(93.6)
Educational level				
No formal education	9(33.3)	24(32)	15(19.2)	36(25.5)
Primary education	0(0)	27(36)	30(38.5)	42(29.8)
Secondary education	15(55.6)	21(28)	30(38.5)	54(38.3)
Tertiary education	3(11.1)	3(4)	3(3.8)	9(6.4)
Land ownership				
Self ownership	21(77.8)	69(92)	60(76.9)	111(78.7)
Inherited	6(22.2)	6(8)	12 (15.5)	24(17.1)
Sharecropping	0	0	3(3.8)	3(2.1)
Rentage	0	0	3(3.8)	3(2.1)
Type of cocoa seedling used				
Hybrid	24(88.9)	48(64)	36(46.2)	87(61.7)
F3Amazon	0	21(28)	36(46.2)	87(61.7)
Amelonado	3(11.1)	6(8)	3(7.6)	12(8.5)
Socioeconomic group membership	27(100)	69(92.0)	69(88.4)	132(93.6)
Number of cocoa farms				
1-3	21(77.8)	60(80.0)	48(61.5)	99(70.2)
4-7	6(22.2)	15(20.0)	30(38.5)	42(29.8)
Farm size (ha)	N=27	N=75	N=78	
1-5	15(55.6)	42(56)	39(50)	78(55.3)
6-10	3(11.1)	18(24)	21(26.9)	30(21.8)
>10	9(33.3)	15(20)	18(23.1)	33(23.4)
Mean	8.7±8.0	7.3±7.0	8.4 ±7.7	7.9±7.5

Figures in parenthesis are percentages

was USD 18.4. The total cost (TC) for sole cocoa cropping system was USD 7,764 while the average total cost (ATC)/farmer was USD 288. The gross revenue which was the total amount the farmer makes in the sale of cocoa beans was USD 43,774 and the amount made per farmer was USD 1,621. The gross margin which is gross revenue minus total variable cost is USD 36,508 and the gross margin per farmer was USD 1,352. The net income was USD 43,276 and net income per farmer was USD 1,603. The profit which is the total amount that the farmers gains from this farming enterprise after removing all the cost from the sale of cocoa beans was USD 36,010 and profit made per farmer was USD 1334. For technical reasons, this study did not separate the gross revenues between cocoa and other crops.

Table 3 presented the cost and returns analysis for cocoa/tree cropping system in Nigeria. The total variable cost (TVC) was USD 16,538 and the average variable cost (AVC)/farmer was USD 212. The total fixed cost (TFC) was USD 1,465 and the average fixed cost (AFC)/farmer was USD 18.8. The total cost which is the sum of the total variable cost and total fixed cost was USD 18,003 and the average total cost/farmer was USD 231. The gross revenue of cocoa/tree cropping system in Nigeria was USD 124,104 and the average gross revenue (GR)/farmer was

Table 2. Cost and returns analysis for sole cocoa cropping system, cocoa/tree crop farming system and cocoa/arable crops farming systems

Item	Cost and returns (USD)		
	Sole cocoa cropping system	Cocoa/Tree crop farming system	Cocoa/Arable crops farming system
Total variable cost	7266	16,538	14,916
Average variable cost/farmer	269	212	199
Total fixed cost	498	1465	1,300
Average fixed cost/farmer	18	18	17
Total cost	7764	18,003	16,215
Average total cost/farmer	287	231	216
Gross revenue	43,774	124,104	109,849
Average gross revenue/farmer	1,621	1591	1465
Gross margin	36,508	107,567	94,934
Gross margin/farmer	1352	1379	1266
Net income	43,276	122,639	108,550
Net income/farmer	1602	1572.29	1447
Profit	36,010	106,102	93,634
Profit/farmer	1334	1360	1249

Table 3. Determinants of the revenue of sole cocoa cropping system

Variable	Coefficient	T	P>|t|
Age	0.1416	0.15	0.884
Marital status	0.3054	0.88	0.388
Educational level	-0.2275 ***	-3.06	0.006
Cost of seedling	0.1772 ***	3.45	0.003
Cost of fungicide	-0.4917 **	-2.26	0.035
Constant	-0.8183	-1.16	0.262
N = 27			
R-squared	0.6985		
F	7.72		

Notes: p<0.01=1% ***; p<0.05=5% **; p<0.1=10% *.

USD 1,591. The gross margin was USD 107,567 and the gross margin/farmer was USD 1,379. The net income was USD 122,639 and the Net Income/farmer was USD 1,572. The profit made by farmers that practice cocoa/tree cropping system was USD 106,102 and the Profit/farmer in the study area was USD 1,360.

The cost and returns analysis for cocoa/arable cropping system are presented in Table 4. The total variable cost was USD 14,916 and the average variable cost/farmer was USD 199. The total fixed cost was USD 1,300 and the average fixed cost/farmer was USD 17. The total cost was USD 16,215 and the average total cost/farmer was USD 216. The gross revenue was USD 109,849 and the average gross revenue/farmer was USD 1,465. The gross margin was USD 94,934 and the gross margin/farmer was USD 1,266. The net income USD 108,550 and the net income/farmer was USD 1,447. Profit resulted from cocoa/arable cropping system was USD 93,634 and the profit/farmer was USD 1,249. Cocoa/tree and cocoa/arable cropping systems were more profitable than sole cocoa cropping system. Farmers should be encouraged to venture into this profitable venture. Ngwang & Meliko (2021); Yahaya *et al*.(2015); and Ononja *et al*. (2012) confirmed the profitability of cocoa production in Cameroon, Ghana, and Nigeria.

Table 5 presented the determinants of the revenue of sole cocoa cropping system. The result showed that the regressors can explain 69.9% of the variations in the dependant variables, that is, the coefficient of determi-

Table 4. Determinants of revenue for cocoa/arable crops cropping system

Variable	Coefficient	T	P>|t|
Age	-0.3694	-0.88	0.382
Gender	0.7711***	5.24	0.000
Marital status married	0.1648***	4.67	0.000
Educational level			
Primary	0.2367	1.37	0.177
Secondary	0.1278***	5.05	0.000
Tertiary	0.7732***	3.22	0.002
Cost of seedling	1.3293	0.62	0.537
Cost of fertilizer	-0.2148***	-3.29	0.002
Cost of fungicide	0.1316***	3.21	0.002
Cost of Insecticide	0.1590	1.17	0.245
Cost of herbicide	0.3434	0.27	0.787
Cost of bush clearing	-0.1694***	-3.31	0.002
Cost of land preparation	0.2549***	8.71	0.000
Cost of weeding	0.2785***	5.81	0.000
Cost of planting	-0.2407**	-2.66	0.010
Cost of agrochemical application	0.3364***	6.56	0.000
Cost of harvesting	0.5958***	-6.46	0.000
Constant	-0.2116***	-3.06	0.003
N = 72			
R-squared	0.7693		
F	9.12		

Note: p<0.01=1% ***; p<0.05=5% **; p<0.1=10% *.

Table 5. Determinants of revenue for cocoa/ tree crops cropping system

Variable	Coefficient	T	P>|t|
Age	0.1303**	-2.08	0.042
Gender	0.1144***	5.60	0.000
Marital status	-0.5542***	-4.70	0.000
Educational level			
Primary	0.2638*	1.72	0.092
Secondary	0.8249	0.05	0.964
Tertiary	-0.2919	-0.62	0.535
Cost of seedling	0.1279**	2.52	0.015
Cost of fertilizer	0.3632***	-2.81	0.007
Cost of fungicide	0.7376***	3.27	0.002
Cost of Insecticide	0.2272	0.29	0.773
Cost of herbicide	0.3661**	2.48	0.016
Cost of bush clearing	-0.4190***	4.78	0.000
Cost of land preparation	0.1979***	4.78	0.000
Cost of weeding	-0.1401**	-2.45	0.017
Cost of planting	0.1947***	-4.40	0.000
Cost of agrochemical application	-0.1856	-0.56	0.578
Cost of harvesting	0.7157	1.57	0.123
Constant	0.6261***	4.76	0.000
N = 75			
R-squared	0.8250		
F	13.64		

Notes: p<0.01=1% ***, p<0.05=5% **, p<0.1=10% *.

nation (R^2) was 69.9%. The coefficients for educational level, cost of seedling was all significant at 1% level of probability. This implies that as educational level increases the revenue for sole cocoa cropping system decreases. It is expected that as the educational level of a farmer increases, farmers' level of exposure increases; and the farmer knows that it does not make economic sense to practice sole cocoa farming. Hence, an educated farmer would introduce other crops along with cocoa to sustain themselves economically (Oluyole & Sanusi, 2009). Also, as the cost of seedling increases the revenue of sole cocoa cropping

system increases. This may be that the farmers need to plant more seedlings on another land or the hectare of the land used as increase. As farmers plant more seedlings, more harvest is expected and then more profit. Similarly, cost of fungicides was significant at 5% level of probability with a negative coefficient. This implies that the lower the cost of fungicide, the higher the revenue from this cropping system. This perhaps may be due to the availability of different types of fungicides among which the farmers can choose.

The result of the regression analysis of the determinants of revenue for cocoa/arable crops cropping system are showed in Table 6. The result shows that the regressors can explain 76.9% of the variations in the dependant variables, that is, the coefficient of determination (R^2) was 76.9%. The coefficients for gender, marital status, educational level, cost of fertilizer, cost of fungicide, labour cost on bush clearing, land preparation, weeding, planting, harvesting and agrochemical application were all significant at 1 and 5% levels of probability, respectively. The positive signs of the inputs' coefficients showed that the enterprise conforms to the rule of the economics of scale, that is, the more output generated, the more inputs that would be needed to be able to cope with the increased output. Invariably, more output brings about more revenue. Therefore, an increase in all these inputs (labour cost on land preparation, weeding, and harvesting) is necessary but not compulsory to generate more revenue on cocoa/arable crops production in the study area. Furthermore, the negative signs of the coefficients of fertilizer cost, labour cost on bush clearing and labour cost on planting, respectively indicate an inverse relationship between the costs and the revenue generated from the enterprise. Moreover, as the educational level of the farmer increases the revenue generated from cocoa/arable crops enterprise increases. This is in tandem with Ammann *et al*. (2022) who opined that education plays a great role in the acceptance of new techniques/technology by farmers. Furthermore, the coefficient of the marital status revealed a positive and 1% level of probability. This implies that married farmers practicing cocoa/arable crop enterprise are likely to have more revenue compared with their unmarried counterparts. This is because family labour help on the farm to boost farmer's production

Table 7 below showed the result of the regression analysis of cocoa/tree crop cropping system. The result shows that the regressors can explain 82.5% of the variations in the dependent variables, that is, the coefficient of determination (R^2) was 82.5%. The coefficients for age, gender, marital status, educational level, cost of seedling, cost of fertilizer, cost of fungicide, cost of herbicide, labour cost of bush clearing, land preparation, weeding, planting was all significant. The positive signs of the coefficients of the inputs (cost of seedling, cost of fertilizer, cost of fungicide, cost of herbicide, labour cost of land preparation, and planting) show that the enterprise conforms to the rule of the economics of scale, that is, the more output generated, the more inputs that will be needed to be able to cope with the increased output. Invariably, more output leads more revenue (Oluyole *et al*., 2022). Therefore, an increase in all these inputs is necessary but not compulsory to generate more revenue on cocoa/ tree crop production in the study area. The negative sign of the coefficients of the inputs (labour cost of bush clearing, weeding) indicates that as the costs of the input decrease, the revenue that is generated from the enterprise increases. Akinniran & Taiwo (2016) confirmed that both cost of seedlings and cost of labour are major factors influencing the profitability of cocoa farmers.

It is thus recommended that cocoa farmers and other stakeholders in cocoa industry should device means of reducing all the cost items that affected each of the cropping systems for optimum productivity. This

could be achieved through trainings on the use and affordability of different resource inputs such as fungicides, insecticides, herbicides and fertilizers.

CONCLUSIONS

The study was carried out on the economic analysis of cocoa production cropping pattern in Nigeria, West Africa. The study revealed that cocoa/tree cropping system was the most profitable among the three identified cropping systems in the study area. It showed a profit of about USD 106,102 while cocoa/ arable showed a profit of USD 93,634 and sole cocoa showed a profit of USD 36,009, respectively. Furthermore, the determinants of revenue for the three cocoa cropping systems were age, gender, marital status, educational level, cost of seedling, cost of fertilizer, cost of fungicide, cost of herbicide, labour cost of bush clearing, land preparation, weeding and planting.

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