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ECONOMIC ANALYSIS OF UPLAND RICE PRODUCTION IN KATSINA STATE, NIGERIA

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ABSTRACT

The study analysed economic analysis of upland rice farmers in Katsina State, Nigeria. We collected data using questionnaires between July and November 2023, from 239 upland rice farmers in three Local Government Areas (LGAs) under Zone II of Katsina Agricultural & rural development (KTARDA) of the state. Using means, percentages, frequency distributions, we analyzed the data and performed a multiple regression using the ordinary least squares method. The data were further subjected to efficiency analysis. Results showed that availability of land, capital, labour, seeds, fertilizer and other inputs had a positive effect on rice output. Cobb- Douglas was the lead equation and the component variables jointly explained 89% of the variation in rice output. The efficiency analysis showed that land and labour were over utilized while seeds and fertilizer were under-utilized. The overall function shows that the farmers were producing at the region of increasing returns to scale, implying that the productivity was not at the optimum level. To attain the optimulity in use of input resources and produce efficiently, the rice farmers should decrease their use of land and labour, and increase the use of improved seeds and fertilizers. **Keywords:** Allocative, Efficiency, Inputs, Production and Rice.

INTRODUCTION

Rice is an important crop for the attainment of food and nutrition security in Nigeria because it is now most staple food in the country. Although rice production is taking place in most parts of the country, local production could not meet demand because of rapid population growth, urbanization and change in consumer preferences in the last decade. The high cost of rice importation has led the Federal Government of Nigeria to strongly encouraged domestic production by providing the enabling environment for the development of a vibrant rice sector that attracts local and foreign investments (FMARD, 2020).

Rice is no longer a luxury food to millions of Nigerians but has become the cereal crop which forms a major source of calories for the rural and urban poor, with demand growing at an annual rate of 5% (WARDA, 2022). Nigeria is the largest producer of rice in the West Africa sub-region. Nigeria has the potential and suitable Agro-ecologies (upland, rainfed lowland, irrigated lowland, deep water and mangrove swamp) to attain self-sufficiency in rice production. Researchers estimate that Nigeria's potential land area for rice production ranges from 4.6 to 4.9 million hectares. But only about 1.7 million hectares of this land are presently being cropped to rice. The upland rice ecology represents 25% (425,000ha) of the 1.7 million hectares. Upland rice production accounts for 20% of the total rice produced in Nigeria. With the development of New Rice for Africa (NERICA) for upland production systems, the number of farmers had shown interest in growing upland rice (WARDA, 2022).



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Despite the arable land, growing demand for rice and the Federal government and Katsina State interventions through various programs and policies, the rice sector has not been far from its low productivity in Katsina State. Researchers have conducted many studies on rice in the state, focusing strongly on the value chain, comparative advantage, competitiveness, and other aspects. However, there is no research carried out to study the production of Upland rice and its economic analysis in the state. In order to close this widening gap in knowledge, the research becomes necessary.

MATERIAL AND METHOD

The Study Area

Katsina State is the study area. The state lies between longitudes 110 and 130East of Greenwich meridian and latitudes 60 and 90 north of the equator. It covers a land mass of 23,938 square kilometers with a projected population of 10,368,500 by National population commission of Nigeria & National bureau of statistic (NPC & NBS,2022). The state is sharing a boundary with Kaduna in the south, Niger Republic to the north, Zamfara to the west and Jigawa and Kano States to the east (KTSG official website, 2021).

The weather in Katsina State varies according to the season of the year. It is cool in the morning, hot in the afternoon and cool in the evening. Harmattan period (November-February) is usually cooler, windy and dust because of northeast trade wind (KTG, 2000). The State has about 863,000 farm families and cultivated land area of 1.64m ha (KTSG official website, 2021). The crops grown in the area include Cotton, Cowpea, Sorghum, Millet, Groundnut, Rice, Maize, Wheat and some vegetables. They also keep livestock, such as cattle, sheep, goats, and poultry. Katsina State is has Agro-allied industries such as flour mills, cotton crushing companies, cotton ginneries and oil mill (KTSG official website,2021) Katsina State is the study area, but because of the predominance of Upland rice production, time and financial constraints, Bakori, Danja and Kafur Local government areas are use as the case study for economic analysis of upland rice production in the state. The selection was based on accessibility. Notable programs designed to facilitate economic growth, development and poverty reduction in the state, such as the Bank of Agriculture (BOA), and Community Bank, are in these areas.

Sampling Techniques

The researchers employ multi-stage sampling techniques. The first involved the purposive selection of Katsina Agricultural and Rural Development Authority Zone II Funtua, because of the predominance of upland rice production in the area. Random sampling was used to select three (3) Local Government areas (L.G. A'S) out of eleven (11) L.G. A'S in the zone. The L.G. A'S selected are Bakori. Danja & Kafur Local Government areas, respectively. With the help of local government branches leaders of Rice association of Nigeria, we randomly selected four (4) farming communities from each selected L.G. A'S, resulting in twelve (12) farming communities. In the last stage, using Yamane, T. (1967) formula and proportionate sampling, a total of two hundred and thirty-nine (239) upland rice farmers were selected. The following expression was used to determine the sample size:

.... (1)

$$n = \frac{n}{1 + (N)e^2}$$

n =Sample size determination

N = Total number of Upland rice farmers in all farming communities

 $e^2 = \text{Confidence level } (0.05)^2$

1 = Constant

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While proportionate sampling is expressed as: $n = \frac{X}{D} \times N$

Where:

n = Sample size of Upland rice farmers selected per farming community

X = Number of Upland rice farmers in farming community

D = Total number of Upland rice farmers in all 12 farming communities

N = Recommended sample size by Yamani's Formula.

The proportionate distribution of wheat farmers is computed as follows:

Table: 1 Sample size of the Rice farmers

S/N	LGA	Farming Communities	Population of the Rice	Number of Rice
		Selected	Farmers	Famers Selected
1	DANJA	Tsintsiya	67	27
		Tandama	43	17
		Kokani	28	11
		Tsangamaawa	70	28
2	BAKORI	Tsiga	48	19
		Kurami	80	32
		Dawan-Musa	42	17
		Barde	27	11
3	KAFUR	Gozagi	43	17
		Dan-kanjiba	54	22
		Yari-bori	30	12
		Rugaji	65	26
	TOTAL		597	239

Source: Author recognisance survey 2023 Data Collection

Data was collected from the randomly selected rural farmers using questionnaires. The researcher and trained enumerators conducted a field survey between July and December 2023 to collect the data. They used a pre-tested structured questionnaire and conducted two-visit interviews with randomly selected rural farmers. Data collected on the socio-economic background of the respondents, such as educational level, age, marital status, major and minor occupation, number of plots, size of the farm and so on.

Analytical Tools

Our analysis of the collected data involved both descriptive and inferential statistics. Descriptive statistics such as mean, percentages and frequency distribution are used to analyse the socio-economic characteristics of the rice farmers. Inferential statistical tools, such as the Ordinary Least Square multiple regression was used to determine factors that influence rice output. Here is the implicit form of the model:

Q = $f(X_1, X_2, X_3, X_4, X_5, X_6, e)$ Where; Q = Output of Rice (Kg) X_1 = Farm Size (ha) X_2 = Capital (\mathbb{N}) X_3 = Labour (Man-days) X_4 = Seed (Kg) X_5 = Fertilizer (Kg) X_6 = Other inputs (\mathbb{N}) e = Error term

... (3)

.... (2)



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As expected, a priori that the coefficients of X_1 , X_2 , X_3 , X_4 , X_5 , X_6 , > 0. Four functional forms of the multiple regression model; linear, semi-log, Cobb-Douglas and exponential were estimated and a lead equation selected.

Determination of allocative efficiency

By using any of the six inputs, the first derivative measures the marginal physical product resulting from the output of rice measured in kg. This would make it easy to calculate price efficiency, which is mathematically given as :

Allocative efficiency (E) = $\frac{MPP \times PQ}{Pi}$ = $\frac{MVP}{Pi}$... (4)

Where:

$$\begin{split} MPP &= dQ/dXi = \text{ marginal physical product of the input} \\ PQ &= \text{price per unit of output} \\ Pi &= \text{price per unit of input or the opportunity cost of the input.} \\ MVP &= \text{Marginal value product.} \\ The condition for efficiency is: \\ \underline{MPP} &= 1 \\ Pi \end{split}$$

RESULTS AND DISCUSSION

Socioeconomic background of farmers

The distribution of upland rice farmers according to Socio-economic background was presented in Table 2. The result show that 26.6% of the upland rice farmers had Qur-anic education, **25%** had primary education while only 12% had adult and higher education. This result implies that the upland rice farmers hid low educational qualifications. This could lead to inefficient resource use and low income. The result further reveals that 24% of the respondents age was 41-45 years, while 21% of them were age 36- 40 years (Table 2). The mean age of the farmers was 38 years, which implies that the farmers were at the active stage of life to produce the needed quantities of rice if given the enabling environment such as input support with high possibility of adopting innovation unlike older age.

The finding was in line with that of Ogbe *et al.* (2017), who revealed that majority of farmers in South Eastern Nigeria were between the productive age of 31 and 50. Males are the majority (85%) of the upland rice farmers in the study area. Females were less involved because of the high labour requirements and land ownership pattern which favour the males. However, the result is contrary to the finding of Nwall and Maureen (2019) in Abakalaki local government of Ebonyi State of Nigeria where the authors reported that 62% of the rice farmers and marketers in Abakalaki were females while 38% were male. Married farmers were in the majority (78%) while 22% of them were still single. Since most of the farmers were married, they have added responsibilities that would make them put in more effort to increase farm output and incomes to fend for their families.

The distribution of upland rice farmers according to farming experience (Table 3) showed that 40.6% of the farmers had 11-15 year's farming experience, while 21% of them had 6-10 years experiences in rice farming. The mean years of experience by the farmers in rice farming was 20.1

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years, which implies that the upland rice farmers had reasonable years of experience in rice production to allow them to optimize resources to improve production.

Table 2: Socio- Economic characteristic of the Upland rice Farmers						
Variables $(n = 239)$	Frequency	Percentage				
Age (Years)						
17-25	18	7				

17-25187 $26-30$ 26 11 $31-35$ 38 16 $36-40$ 51 21 $41-45$ 57 24 $46-50$ 28 12 $51-55$ 21 9 Mean age 38 Sex V Male 203 85 Female 36 15 Married 186 78 Single 53 22 Level of Education V No Education 0 0 $Quranic only$ 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation V 29 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	Age (Teals)		
26-30 26 11 31-35 38 16 36-40 51 21 41-45 57 24 46-50 28 12 51-55 21 9 Mean age 38 9 Sex 15 9 Male 203 85 Female 36 15 Married Status 15 Married 186 78 Single 53 22 Level of Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	17-25	18	7
31-35 38 16 $36-40$ 51 21 $41-45$ 57 24 $46-50$ 28 12 $51-55$ 21 9 Mean age 38 9 Sex 12 9 Male 203 85 Female 36 15 Marital Status 15 Married 186 78 Single 53 22 Level of Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4	26-30	26	11
36-40 51 21 41-45 57 24 46-50 28 12 51-55 21 9 Mean age 38	31-35	38	16
41-45 57 24 46-50 28 12 51-55 21 9 Mean age 38 9 Sex 12 9 Male 203 85 Female 36 15 Marital Status 15 15 Marited 186 78 Single 53 22 Level of Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 35 12 Occupation 12 0 Farming only 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	36-40	51	21
46-50 28 12 51-55 21 9 Mean age 38	41-45	57	24
51-55 21 9 Mean age 38 Sex 1 Male 203 85 Female 36 15 Marital Status 15 Married 186 78 Single 53 22 Level of Education 0 0 No Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	46-50	28	12
Mean age 38 Sex	51-55	21	9
Sex Male 203 85 Female 36 15 Marital Status 15 Married 186 78 Single 53 22 Level of Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	Mean age	38	
Male 203 85 Female 36 15 Marital Status Married 186 78 Single 53 22 Level of Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	Sex		
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Marital Status 186 78 Married 186 78 Single 53 22 Level of Education 22 No Education 0 0 Qur'anic only 62 26 Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 120 50.2 Trading/Farming 70 29.3 Civil Service/Farming 20 8.4 Middleman/Farming 29 12.1	Female	36	15
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Single5322Level of Education00No Education00Qur'anic only6226Adult Education5422Primary6025Secondary3515Post-Secondary2812OccupationFarming only12050.2Trading/Farming7029.3Civil Service/Farming2912.1	Married	186	78
Level of Education00No Education00Qur'anic only6226Adult Education5422Primary6025Secondary3515Post-Secondary2812Occupation50.2Farming only12050.2Trading/Farming7029.3Civil Service/Farming2912.1	Single	53	22
No Education00Qur'anic only6226Adult Education5422Primary6025Secondary3515Post-Secondary2812OccupationFarming only12050.2Trading/Farming7029.3Civil Service/Farming2912.1	Level of Education		
Qur'anic only6226Adult Education5422Primary6025Secondary3515Post-Secondary2812OccupationTFarming only12050.2Trading/Farming7029.3Civil Service/Farming2912.1	No Education	0	0
Adult Education 54 22 Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 70 50.2 Trading/Farming 70 29.3 Civil Service/Farming 29 12.1	Qur'anic only	62	26
Primary 60 25 Secondary 35 15 Post-Secondary 28 12 Occupation 70 50.2 Trading/Farming 70 29.3 Civil Service/Farming 29 8.4 Middleman/Farming 29 12.1	Adult Education	54	22
Secondary3515Post-Secondary2812Occupation50.2Farming only12050.2Trading/Farming7029.3Civil Service/Farming208.4Middleman/Farming2912.1	Primary	60	25
Post-Secondary2812Occupation50.2Farming only12050.2Trading/Farming7029.3Civil Service/Farming208.4Middleman/Farming2912.1	Secondary	35	15
OccupationFarming only12050.2Trading/Farming7029.3Civil Service/Farming208.4Middleman/Farming2912.1	Post-Secondary	28	12
Farming only12050.2Trading/Farming7029.3Civil Service/Farming208.4Middleman/Farming2912.1	Occupation		
Trading/Farming7029.3Civil Service/Farming208.4Middleman/Farming2912.1	Farming only	120	50.2
Civil Service/Farming208.4Middleman/Farming2912.1	Trading/Farming	70	29.3
Middleman/Farming 29 12.1	Civil Service/Farming	20	8.4
	Middleman/Farming	29	12.1

Source: Field study, 2023

Less than half (44.0%) of the farmers had 11-20 persons in their families, while 37% of them had 6-10 persons. About 19% of the farmers had 1-5 persons in their families. However, the mean family size was 9 persons (Table) 3. These large family sizes had the advantage in labour supply for rice production.

Majority (66.5%) of the farmers had farm sizes of 1-5 hectares, while 25.1% of them had sizes of less than 1 hectare and 8.4% of farmers had more- than 5 hectares (Table 3). The mean farm size was 3 hectares, which implies that most of the upland rice farmers sampled are small-scale farmers.

Variable (n= 239)	Frequency	Percentage
Farming Experience (Years)		
1-5	20	8.4
6-10	50	21
11-15	97	40.6
16-20	29	12.1
21-25	24	10
26 – Above	19	7.9
Mean	20.1	
Family size (Number of person)		
1-5	45	19
6-10	88	37
11-20	106	44
Mean	9	
Farm size (ha)		
<1	60	25.1
1-5	159	66.5
> 5	20	8.4
Mean	3	

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Source: Field study, 2023

Annual farm and off-farm income

The distribution of upland rice farmers according to annual farm income is presented in Table 4. The result shows that 42% of the respondents earned an annual farm income of \$1,000,000 and above; 20% of them earned \$550,000 -\$995,000. The mean annual farm income was \$479,545.45, which is reasonable for a small-scale farmer and is an encouragement to put in more effort into rice production and other farming activities.

The result shows that 45% of the respondents earned annual off-farm incomes of N500,000 - Above while 24.3% of them earned between N400,000–N499,000 (Table 4). Also, 3.3 and 6.3% of the respondents earned annual off-farm incomes of N50,000-N99,000 and N100,000–N199,000 respectively.

Annual Farm income (N)	Frequency	Percentage
100,000-245,000	11	4.6
250,000 -345,000	18	7.5
350,000-445,000	30	12.5
450,000 -545,000	32	13.4
550,000 -995,000	48	20
1000,000 - Above	100	42
Total	239	100
Mean Farm income (N)	479,545.45	
Annual Off-Farm income(₦)		
50,000-99,000	8	3.3
100,000 - 199,000	15	6.3
200,000 -299.000	21	9
300,000 - 399,000	29	12.1
400,000 - 499,000	58	24,3
500,000 – Above	108	45
Total	239	100
Mean Off-farm income (₦)	305,111.11	

Table 4: Distribution of Upland rice farmers according to Annual farm and Off-farm income.

Source: Field study, 2023



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The mean off-farm income per annum was \$305,111.11. Thus, besides a reasonable farm income earned by the farmers. They also earned some of farm income per annum, showing that even during the off-farm season, the rice farmers gainfully engaged in other income-generating activities.

Estimation of production by upland rice farmers

Results of the multiple regression analysis are shown in Table 5. The functional forms were linear, semi-log, Cobb-Douglas and exponential. The Cobb-Douglas function had the highest coefficient of multiple determination (R^2) highest F-cal and highest number of significant variables, and therefore taken as the lead equation. To give the production function for upland rice production in the study area. Thus, we provided the equation as follows;

InQ = 86.9108 + 0.0129InX₁ + 0.0282InX₂ +0.0871InX₃ +0.0790InX₄+0.1095InX₅ +0.0208 InX₆. The sign of the coefficients for land (X₁), Capital (X₂), Labour (X₃), Seeds (X₄), Fertilizer (X₅), and other inputs (X₆) were positive and significant at 1% except for labour that was significant at 5%. The coefficient of determination showed that these inputs jointly explained about 89% of variation in rice output in the area. Coefficients of the explanatory variables, which are the direct elasticities of production, reveals that a 10% increase in Land, labour, seeds, fertilizer and other inputs will lead to 0.0129, 0.0282, 0.0871, 0.0790, 0.1095, and 0.0208 percent increase in rice output, respectively. The sum of the elasticities, which was 0.34, shows that the farmers were operating within the region of increasing returns to scale.

Inputs &	Cobb-Douglas	Exponential	Linear Function	Semi-log Function
Important statistic	Function	Function		
Land (X ₁)	0.0129	0.0094	19.4423	2.6992
	(3.6280)**	(2.7667)**	(2.3075)**	(3.9122)**
Capital (X ₂)	0.0282	0.0075	11.5431	3.4811
	(2.8338)**	(2.3906)*	-1.0998	-1.0898
Labour (X ₃)	0.0871	0.0049	6.2319	3.2028
	(2.5981)*	-1.3106	-1.6158	-1.8093
Seeds (X ₄)	0.0790	0.0067	16.3748	1.9712
	(3.1934)**	-1.2408	(2.2233)*	-1.2528
Fertilizer (X5)	0.1095	0.0053	6.5641	2.7093
	(3.6233)**	-1.1552	(3.0063)**	-1.2236
Other Inputs (X ₆)	0.0208	0.0089	10.1803	3.8414
	(3.4041)**	(2.7552)*	-1.2120	-1.2675
Constant	86.9108	65.0198	118.9314	113.8302
\mathbb{R}^2	0.7943	0.6401	0.5054	0.3826
F*	81.6558	12.4579	8.7014	5.6598

Table5:Results of multiple regression analysis of the relationship between rice output and inputs.

Source: Field study, 2023 **Note**: Figure in parentheses are t-ratios, *t-ratio significant at 5% level, **t-ratios significant at 1% level.

Estimation of price or allocative efficiency

Allocative efficiency indices in Table 6 show the resource utilization efficiency by the rice farmers. The results of regression analysis in Table 5 showed that the Cobb- Douglas function gave the lead equation and the coefficients of the lead equation are also the marginal physical products (MPP) of the inputs, as shown in Table 6. The product of the MPP and the output price divided by the sample mean produced the marginal value product (MVP). Also, the ratio of the



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MVP and factor prices gave the price or allocative efficiencies. These results reveal that land and labour were over utilized while seeds and fertilizers were underutilized by the upland rice farmers. Land in the study area is in high demand, so rent is high and efficiency of use has to be high because of competition. Labour hand is available as both hired and family labour and results in what has been described in Saleh and Oyinbo (2017) and Idiong (2006) as labour saturation; this leads to inefficiency of utilization, especially in small farm plots.

		•	-	-
Table	6:	Computation	of allocative or	price efficiency

Inputs and Output prices	Elasticity	APP	MPP	Marginal Value Product (MVP)	Factor Prices (FC)	Price allocative efficiency Index	or
Land (ha)	0.0129	6190.5	80.5	575,000	₩250000/ha	2.3	
Labour (Mandays)	0.0871	86.1	6.7	48,000	₩40000/ha	1.2	
Seeds (Kg)	0.0790	160	11.2	15,900	₩1325/kg	12	
Fertilizer (50kg)	0.1095	81.9	9,01	9,800	₩700/kg	14	

Source: Field study, 2023

CONCLUSION AND RECOMMENDATIONS

The upland rice farmers in Katsina State utilized their resources at varying degrees of efficiency. Overall equation shows that the farmers were operating in the increasing returns to scale region. The implication is that inputs need to be increased to further increase output. The analysis of individual inputs, however, showed that land and labour were over utilized while seeds and fertilizers were under- utilized. This resulted in an overall low efficiency of the upland rice farmers in Katsina State. The role played by these rice farmers in supplying food in the area is quite important and they need to be encouraged. We recommend that the awareness to be created in such a way that the rice farmers would understand sources and modes of credit acquisition and availability and use of agro-chemicals. Equally, they be taught some fundamental farm management skills which at least will enable them to plan, evaluate and appraise their farm business and be able to predict the economic implication of their investment in rice production. These factors put together would increase the efficiency of the upland rice farmers and improve the national economy.

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