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Research Paper

A comparative analysis of upland and wetland yam production in Southwest, Nigeria

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Abstract. The study presented a comparative analysis of upland and wetland yam production in southwest Nigeria. It made use of data obtained through the administration of copies of well structured questionnaire to 320 respondents selected by multistage, purposive and random sampling methods. Both parametric and non-parametric statistical tools were used to analyze the data. Majority (80.6% upland and 75.4% wetland) of the respondents were educated male youths of 49 years and below. Production output was statistically and significantly influenced by household size, farm size and cost of inputs for upland farms while it was statistically and significantly determined by gender, marital status, educational level, farm size, amount of credit obtained and cost of inputs for wetland farms. Gross margin, net farm income and net return on investment were ₦156,059,460; ₦150,504,020 and 1.01 (upland farms); ₦152,685,341; ₦147,384,681 and 0.92 (wetland farms) respectively implying a profitable enterprise. Production was most seriously constrained by lack of capital, scarcity/high cost of seed yams, and pests and diseases infestation. Production could improve if the constraints identified by the study are addressed through the formulation and implementation of sound policies such as the injection of more funds into yam production enterprise and articulated extension delivery system to educate farmers on yam minisett techniques.

Keywords: Comparative analysis, Upland, Wetland, Yam production, Southwest, Nigeria.

INTRODUCTION

Agricultural sector has always been the bed rock of the Nigerian economy and the only one so far with the efficacy to give the country the sort of sustainable economic growth needed to carter for the wellbeing of a growing population (Salisu, 2013). More so, the sector is the largest employer of labour and contributed to the country's economic output or Gross Domestic Product (GDP). According to World Bank Report (2013), the sector contributed 47% to the Nation's GDP in 2012. The food crop sub-sector (with maize, sorghum, millet, rice, yam, cocoyam and cassava as the main food crops grown in the country) contributed about 28% of GDP representing about 75 to 76% of the share of the agricultural sector's contribution of GDP (CBN, 2012).

Yam as an annual tuber and monocot plant is grown in all the states of the federation with consistent growth both in area under cultivation and output between 2003 and 2007 (FMA & WIR, 2008). Nigeria is reported to be the largest producer of yam with estimated total output of 37.1 million tones representing about 67% of the total world production in 2011 (FAO, 2012). In South west Nigeria, yam is an important food crop grown for its edible tuber. In the region, yam is food and the people eat more than three times a day (Babaleye, 2005; Fasasi, 2006; Osunde, 2008). In addition to its importance in the diet, it is prominent in traditional festivals, marriages, burials and indeed in almost all social, cultural, religious and economic gatherings (Simonyan and Obiakor, 2012).

In South west Nigeria, yam cultivation is carried out both in the upland and wetland farms and still depends largely on labour intensive traditional techniques of production (Bamire and Amujoyegbe, 2005; Oluwatusin, 2011). Many aspect of production like clearing, planting, weeding, staking and harvesting requires considerable inputs of labour. However, as rural labour becomes more scarce and expensive, and the prices of inputs increase, the price of yam in the market will increase making it a luxury food rather than a stable. In a bid to encouraged

domestic food production, the government initiated different agricultural programmes such as National Economic Empowerment and Development Strategies (NEEDS) aimed at 6% annual growth in agricultural export and 95% National food sufficiency. In spite of government investment in food crop sub-sector, production has remained low and the goal of attaining self-sufficiency in food production remains a long-term target. The reason could probably be due to the subsistence system of its production, high production costs and the need for appropriate land improvement technologies for restoring, replenishing, conserving and maintaining the quality of agricultural land in order to increase farmers' yields and income under the prevailing rate of population growth. Other reasons could be due to production constraints such as root rot disease, lack of storage facilities, insufficient market information and lack of funds (Njoku, 2008; Ugwumba, 2011). It is against this backdrop that this study was initiated to determine the effect of socio-economic characteristics of upland and wetland yam farmers on production output, estimate upland and wetland yam enterprise profitability and identify the problems associated with upland and wetland yam production in the area.

METHODOLOGY

The study was conducted in south western Nigeria. The area lies between longitude 2° 31′ and 6° 00 East and latitude 6° 21′ and 8° 37′ North of equator (Agboola, 1979; Omojola; 2014) with total area of 77,818 km^2 and estimated population of 27, 340, 254 people (NPC, 2006). The area is bounded in the east by Edo and Delta States, in the North by Kwara and Kogi States, in the west by Republic of Benin and in the south by the Gulf of Guinea (Faleyimu et al., 2010; Mayowa et al., 2013). The area represents two ecological zones-forest regrowth and southern Guinea savannah ecological zones. The mean annual temperature ranges from 800 to 1500 mm in the rainforest belt (Bamire and Amujoyegbe, 2005). The people of south west Nigeria are majorly agrarian, cultivating basically food crops such as maize, yam, cocoyam, etc. The area was selected for the study because of the preponderance of upland and wetland yam farming. Multistage, purposive and simple random sampling technique was used to select 160 upland and 160 wetland yam farmers to arrive at a sample size of 320. In the first stage, two states (Ekiti and Osun) were purposively selected from the six states in the South west geopolitical zone. The selection was based on the preponderance of upland and wetland yam farmers evidenced from the pre-survey study and the familiarity of the researcher with the terrain of the selected states. Stage II involved random selection of 2 LGAs each from the selected states to arrive at 4 LGAs. At stage III, two communities were randomly selected from each of the four selected LGAs to arrive at eight communities.

Finally, simple random method was used to select twenty (that is, ten each of upland and wetland) yam farmers from each of the eight selected communities to arrive at 320 respondents at stage four. Data were obtained by the administration of well structured questionnaire to the respondents. Descriptive statistical tools involving means, frequency distributions and percentages were used to analyze the data generated on socio-economic status and constraints to yam production. Profitability of production and comparison of incomes realized by farmers of the two land types were achieved using cost-return analysis and two-sample T-test respectively while the Ordinary Least Square (OLS) method of multiple regression was used to establish socio-economic determinants of production output. The implicit and explicit forms of the multiple regression used to establish the influence of farmers' socio-economic factors including gender represented by GEN, age (AGE), marital status (MAS), household size (HOS), educational level (EDU), farming experience (FAE), farm size (FAS), amount of credit obtained (ACO), cost of inputs (CIN), extension visit (EXV) and land type (LAT) on production output are given as:

OTP = f(GEN, AGE, MAS, HOS, EDU, FAE, FAS, ACO, CIN, EXV, LAT, ei) and

$$OTP = \beta_0 + \beta_1 GEN + \beta_2 AGE + \beta_3 MAS\ \beta_4 HOS + \beta_5 EDU + \beta_6 FAE + \beta_7 FAS + \beta_8 ACO + \beta_9 CIN + \beta_{10} EXV + \beta_{11} LAT + e$$

Where:
OTP = Output of yam (kilograms)
GEN = Gender (dummy: male = 1: female = 2)
AGE = Farmers age (years).
MAS = Marital status (dummy: Marital = 1, Otherwise = 2).
HOS = Household size (number).
EDU = Educational level (years).
FAE = Farming experience (years).
FAS = Farm size (hectare).
ACO = Amount of credit obtained (₦).
GN = Cost of input (₦).
EXV = Extensive visit (number of times per production season).
LAT = Land type (dummy: upland = 1; wetland = 2).
β_0, β_1, β_2---β_{11} = Parameters to be estimated
ei, = stochastic error term.

It is hypothesized that means of net farm incomes realized from the two land groups are not significantly different and the independent variable are not significant factors in the determination of the farmer production output. The data were fitted with four functional forms of the regression model namely linear, exponential, semi-log and double log. The functional form which produced the best output in terms of sizes, signs and number of significant parameter estimates, over all significance of

the regression shown by F-statistics, percentage of variation in production output determined by R^2, and the existence or non-existence of auto-correction given by Durbin- Watson statistic was chosen as the lead equation. The functional forms are given as:

Linear: OTP = β_0 + β_1 GEN + β_2 AGE + β_3 MAS β_4 HOS + β_5 EDU + β_6 FAE + β_7 FAS + β_8 ACO + β_9 CIN + β_{10} EXV + β_{11} LAT + e

Exponential: OTP= β_0 + β_1 GEN + β_2 AGE + β_3 MAS β_4 HOS + β_5 EDU + β_6 FAE + β_7 FAS + β_8 ACO + β_9 CIN + β_{10} EXV + β_{11} LAT + e

Semi–log: ln OTP = β_0 + β_1 ln GEN + β_2 ln AGE + β_3 ln MAS + β_4 ln HOS + β_5 ln EDU + β_6 ln FAE + β_7 ln FAS + β_8 ln ACO + β_9 ln CIN + β_{10} ln EXV + β_{11} ln LAT+ e.

Double – log: OTP = β_0 + β_1 ln GEN + β_2 ln AGE + β_3 ln MAS + β_4 ln HOS + β_5 ln EDU + β_6 ln FAE + β_7 ln FAS + β_8 ln ACO + β_9 ln CIN + β_{10} ln EXV + β_{11} ln LAT+ e.

The cost and return techniques used in determining profitability of the enterprise is given as:
GM = TR - TVC
NFI = GM - TFC or TR - TC
NROI = NFI/TC

Where:
GM = Gross Margin
TR = Total Revenue
TVC = Total Variable Cost
TFC = Total Fixed Cost
TC = Total Cost
NFI = Net Farm Income (Profit)
NROI = Net Return on Investment

RESULTS AND DISCUSSION

Distribution of the respondents by socio-economic characteristics is shown in Table 1. It could be seen from the table that majority (62.5% upland and 74.4% wetland) farmers were males who were youths (80.6% upland and 75.4% wetland) between 20 and 49 years old. Comparatively, more male farmers engage in wetland yam production than the upland yam farming (Nlerum, 2006; Eyitayo, Anthony and Ige, 2010) and majority of the youths participated more in upland yam farming (Ebewore, 2010; Ugwumba and Omojola, 2012). This could be attributed to the more tedious activities involved in wetland yam farming. Furthermore, the result in Table 1 shows that majority (58.3% upland and 63.1% wetland) farmers were married; household size of 4 to 9 persons (68.7% upland and 62.5% wetland); operating between 1.1 and 3.0 hectares (61.1% upland and 66.2% wetland). All the respondents had one form of formal education or the other with 27.5% upland and 20.6% wetland farmers acquiring primary education; 35.0% upland and 29.4% wetland secondary education and about 27.5% and 50.0% of upland and wetland farmers respectively attended higher institution. Formal education has been noted as an essential tool for the adoption of modern production technologies and effective communication system that encourage increase in the productivity of any agricultural venture (Ugwumba and Omojola 2012). Also Table 1 showed that majority (70.9% and 89.4%) of upland and wetland yam farmers respectively had acquired above 6 years experience in the business, which might have enabled them take better farm management decisions, access agricultural credit and probably attained higher level of economic efficiency and profit.

The hypothesis, means of net farm incomes realized from the two land types are not statistically and significantly different was tested with Two-Sample T-test of the MINITAB STATISTICS. Result of the analysis is shown in Table 2. It could be deduced from the table that there was no statistically significant difference between means of net farm incomes realized from the two land types at 5% probability level. This implied that the wetland and upland yam farmers in the area, on the average, realized the same net farm income.

Tables 3 and 4 show the outputs of the four functional forms of the multiple regression analysis for upland and wetland yam production, respectively. It could be seen from the result that outputs of the exponential and semi-log regression analyses for upland and wetland farms respectively, gave the best results in terms of number, signs and sizes of the significant parameters and were chosen as the lead equations. Out of the eleven regressors, only three factors (household size, farm size and cost of inputs) were statistically significant while the rest eight (gender, marital status, educational level, farming experience, amount of credit obtained, extension visit, land type and age) were not statistically significant at 5% level of probability. For the wetland farms, six of the eleven regressors (gender, marital status, educational level, farm size, amount of credit obtained and cost of inputs) were statistically significant while the rest five (household size, farming experience, extension visit, land type and age) were not significant at 5% level. Among the statistically not significant variables, only land type exerted positive influence on output while the impact of household size, farming experience and age were negative for wetland farms. On the other hand, the statistically not significant variables, marital status, household size, educational attainment, land type and age exerted positive influence on output while the impact of gender, farming experience and extension visit were negative for the upland yam farms.

In upland and wetland farms, the coefficients of farm size were positive and statistically significant at 5% level

Table 1. Socio-economic characteristics of yam farmers in southwest, Nigeria.

Variable	Upland farmers		Wetland farms	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	99	62.5	119	74.4
Female	61	37.5	41	25.6
Total	160	100	160	100
Age				
L20	16	9.7	10	6.2
20-29	38	24.3	16	10
30-39	44	28.5	57	35.5
40-49	43	27.8	43	26.9
50-59	14	7.6	28	17.5
60 and above	5	2	6	3.8
Total	160	100	160	100
Marital status				
Married	94	58.3	101	63.1
Single	66	41.7	59	36.9
Widow(er)	-	-	-	-
Divorced	-	-	-	-
Total	160	100	160	100
Household size				
3-Jan	23	14.4	45	28.1
6-Apr	77	47.5	54	33.8
9-Jul	34	21.2	46	28.7
10 and above	27	16.9	15	9.4
Total	160	100	160	100
Educational level				
Primary	44	27.5	33	20.6
Secondary	56	35	47	29.4
Higher institution	60	27.5	80	50
Total	160	100	160	100
Farming experience (yrs)				
5-Jan	46	29.1	17	10.6
10-Jan	43	27.8	35	21.9
15-Nov	27	16.7	55	34.4
16-20	23	13.9	45	28.1
Above 20	21	12.5	8	5
Total	169	100	160	100
Farm size				
0.1 – 1.0	41	25.7	46	28.8
1.1 – 2.0	55	35.4	64	40
2.1 – 3.0	41	25.7	42	26.2
Above 3	23	13.2	8	5
Total	160	100	160	100

Source: Field survey, 2013.

Table 2. Difference in means of net farm incomes of upland and wetland yam production in Southwestern Nigeria.

Pair of land types	Mean NFI (₦)	Difference between group means (₦)	T-ratio	P	DF
Upland	940,650.13	19,495:87	0.23ns	0.82	316
Wetland	921,154.26				

Source: Field survey, 2013. Notes: NFI = net farm Income T = t – statistics, P = probability, DF = Degree of freedom, ns = Not significant.

Table 3. Estimated determinants of production output (wetland farmers).

Variable	Linear	Exponential	Semi-Log	Double-Log
Constant	13564 (0.99)	4.1112 (20.45)	- 35589 (- 1.12)	3.5132 (7.05)
GEN	454 (0.13)	0.01973 (0.38)	19787 (1.74)**	0.0442 (0.25)
MAS	- 9713 (-2.32)**	- 0.13428 (-2.13)**	- 30749 (-1.95)**	- 0.3122 (1.26)
HOS	117.9 (0.18)	- 0.008113 (-0.82)	-2666 (-0.45)	- 0.09988 (- 1.09)
EDU	801.6 (2.72)**	0.009457 (2.12)**	14922 (2.26)**	0.2049 (1.98)**
FAE	- 34.1 (-0.13)	0.002713 (0.66)	- 2746 (-0.38)	0.0868 (0.77)
FAS	4766 (2.33)**	0.07024 (2.30)**	22775 (2.46)**	0.2955 (2.04)**
ACO	0.007992 (2.29)**	0.00000015 (1.62)	876.3 (2.23)**	0.013776 (2.24)**
CIN	0.017119 (3.23)**	0.00000019 (2.42)**	9733 (2.25)**	0.09044 (1.34)
EXV	295.7 (0.52)	0.008222 (0.95)	N. A	N. A
LAT	3207 (1.02)	0.03839 (0.82)	12604 (1.21)	0.0232 (0.14)
AGE	- 253.9 (-1.19)	- 0.002157 (-0.67)	- 7564 (- 0.44)	- 0.0110 (- 0.04)
R^2	69.2%	66.2%	75.4%	63.9%
R^2 Adj.	63.9%	63.9%	70.4%	61.8%
F – Stat.	5.51	5.50	8.78	8.69
D. W. Stat	1.75	1.62	1.79	1.61

Source: Computed from field survey data, 2013. Note: ** = significant at 5% level. NA = Not available.

of probability. This implied that the farmers with large farm sizes who had adopted good management strategies were likely to produce more output from the business. This conforms to *a priori* expectations and corroborates Ugwumba (2010, 2011) on Egusi Melon and catfish production respectively and Ugwumba and Omojola (2012) on yam production in Ipao-Ekiti.

The coefficient of cost of inputs was positive and statistically significant at 5% level for both upland and wetland farms. This is contrary to *a priori* expectations that cost of inputs should have negative influence on output. This could be attributed to poor management strategies used by some of the yam farmers. The statistically significant cost of inputs' coefficient could imply that increase in investible fund would lead to increase in quantities of inputs used, hence increase in output (Ugwumba and Omojola, 2012).

In wetland farms, the coefficients of educational level, gender and amount of credit obtained were statistically significant and positive at 5% level of probability. This implied that the more the amount of credit and educational attainment obtained by the male farmers, the higher the output realized by them. This is in tandem with Okoye et al. (2004) and Ugwumba and Omojola (2012) on positive effects of higher educational level and amount of credit obtained by yam farmers on output.

Further result of the analysis (Table 3) for upland yam farmers showed that the household size was positive and statistically significant at the 5% level of probability, implying that farmers with large household size were more likely to realize greater output than those with small household sizes. This might be as a result of cheap and unremunerated labour advantage received from the household members. The result in Table 3 for wetland farmers also showed that the coefficient of marital status was statistically significant ($P \leq 0.5$) but negative. The implication is that married farmers could reap the advantage of family labour to increase yam production output at reduced cost.

The coefficient of multiple determinations (R^2) of 65.7 and 75.4% obtained for upland and wetland yam farms respectively implied that 65.7 and 75.4% variations in the production outputs of yam for the respective land types were accounted for by the predictor variables; hence the remaining 34.3 and 24.6% for the respective land types were due to random disturbance. The Durbin-Watson statistic value of 1.89 for upland farmers and 1.79 for wetland farmers, which lies within the benchmark of 2.0 signifies the absence of autocorrelation among observations of the regressor. The F-statistic values of 11.31 for the upland farms and 8.78 for wetland farms indicated that socio-economic characteristics of the yam

Table 4. Estimated determinants of production output (upland farmers).

Variable	Linear	Exponential	Semi-log	Double-log
Constant	-898585 (-0.83)	-19.82 (-0.78)	-51706 (-2.78)	2.4151 (5.56)
GEN	-336.2 (-0.37)	-0.00395 (-0.19)	-1112 (-0.36)	- 0.01056 (-0.15)
MAS	997 (0.72)	0.02156 (0.66)	5450 (1.06)	0.1351 (1.12)
HOS	424.1 (2.16)**	0.011341 (2.44)**	5149 (2.33)**	0.13205 (2.55)**
EDU	85.79 (1.10)	0.002077 (1.13)	864 (0.54)	0.1829 (0.49)
FAE	-42.76 (-0.60)	-0.001443 (-0.86)	401 (0.21)	0.01197 (0.26)
FAS	2360.0 (4.40)**	0.04831 (3.82)**	13028 (4.69)**	0.29227 (4.50)**
ACO	- 0.002731 (-0.90)	-0.0000007 (-0.01)	-73.8 (-0.62)	-0.001516 (-0.55)
CIN	0.007236 (4.84)**	0.0000019 (5.27)**	9328 (3.43)**	0.23805 (0.08)
EXV	-187.9 (-1.06)	- 0.003983 (-0.95)	53.0 (0.22)	0.000473 (0.08)
LAT	23.22 (0.83)	0.0006096 (0.92)	NA (NA)	NA (NA)
AGE	79.20 (1.29)	0.002483 (1.71)	3839 (0.68)	0.1246 (0.94)
R^2	64.6%	65.7%	62.3%	64.4%
R^2 Adj.	60.5%	61.6%	58.4%	60.7%
F – Stat.	10.85	11.31	10.92	1.22
D. W. Stat	1.70	1.89	1.70	1.63

Source: Computed from field survey data, 2013.Note: ** = significant at 5% level. NA = Not available.

Table 5. Estimated profit for yam production in Southwest Nigeria.

Variable	Wetland farms		Upland farms	
	Amount (₦)	%	Amount (₦)	%
Total revenue	307, 613, 255		298, 963, 560	
Variable cost				
Yam seeds	67, 329, 052	42.02	58,384,800	39.33
Herbicides	3, 590, 300	2.24	3,381,600	2.28
Labour	58, 000, 828 .20	36.20	52,020,000	35.04
Fertilizer	20, 084, 272	12.50	24,012,800	16.17
Transportation	3, 144, 300	1.96	2,838,700	1.91
Storage	2, 829, 111 .80	1.77	2,266, 200	1.53
Total variable cost (TVC)	154, 927, 864	96.69	142,904,100	96.26
Fixed cost				
Dep. on machete	1, 350, 370	0.84	1,200,000	0.81
Dep. on hoe	1, 150, 380	0.72	1,325,040	0.89
Dep. on bicycle/motorcycle	1, 021, 000	0.64	1,180,400	0.79
Dep. on basket / head pan	896, 460	0.56	840,000	0.57
Interest on loan	882, 500	0.55	1,010,000	0.68
Total fixed cost (TFC)	5, 300, 710	3.31	5,555,440	3.74
Total cost (TC = TVC + TFC)	160,228,574	100	148,459,540	100
Gross margin (GM = TR – TVC)	152,685,341		156,059,460	
Net farm income (NFI = TR – TC)	147,384,681		150,504,020	
Mean net farm income (MNFI = NFI/n)	921,154.26		940,650.13	
Net return on investment (NROI = NFI/TC)	0 .92		1 .01	

Source: Field survey, 2013; Note: Dep. = Depreciation, % = Percentage

producers together significantly influenced the production outputs of the two land types.

Table 5 shows the estimated profitability of upland and wetland yam production enterprise in the study area. The

Table 6. Constraints to yam production by land type.

Factors	Upland		Wetland	
	Mean score	Rank	Means score	Rank
Lack of capital	3.62	1st	3.58	1st
Scarcity/high cost of quality seed yam	2.92	2nd	2.91	2nd
High cost of labour	2.89	3rd	2.88	3rd
Pests and disease infestation	2.85	4th	2.82	4th
High cost of transportation	2.69	5th	2.78	6th
Lack of modern technology	2.66	6th	2.81	5th
Poor storage facilities	2.60	7th	2.67	7th
Poor market prices	2.33	8th	2.43	8th

Source: Field survey, 2013.

result implicated cost of seed yams as the most important cost variable both in upland and wetland yam production at 39.33 and 42.02% respectively, while depreciation values of basket/head pan was the least cost item with 0.57% for the upland farms and interest on loan with 0.55% was the least cost item for wetland farm.

The farm groups separately generated the following gross margins, net farm incomes, mean net farm incomes and net return on investment values of ₦156,059,460; ₦150,504,020; ₦940,650.13 and 1.01 for upland farms: ₦152,685,341; ₦147,384,681; ₦921,154.26 and 0.92 for wetland farms. Thus in the study area yam farming having recorded positive net farm income and return on investment values for the farm groups was a profitable enterprise. Yam farming has equally been adjudged a profitable enterprise in the previous studies conducted in Southwest Nigeria by Adekayode (2004), Eyotayo et al. (2010), Ugwumba and Omojola (2012) and Omojola (2014). Net return on investment for upland farms was 1.01 and 0.92 for wetland farms implying that the farmers return ₦1.01 and ₦0.92 for every ₦1.00 invested in the business respectively.

Distribution of the respondents according to problems militating against yam production in the area is shown in Table 6. The result indicated that lack of capital with mean score of 3.62 for upland and 3.58 for wetland was the most serious constraints to yam production. Reuben and Barau (2012) also noted inadequate fund as one of the serious problems facing yam production in Taraba State. This was followed by scarcity/high cost of seed yams, high cost of labour, and pest and diseases infestation. For both land types, poor market price was a weak problem.

CONCLUSION AND RECOMMENDATIONS

Both upland and wetland yam production in South West Nigeria proved to be profitable enterprise given the positive values of gross margin, net farm incomes, mean net farm incomes and net return on investments. Production outputs were statistically and significantly determined by socio-economic factors of household size, farm size and cost of inputs for upland farms while gender, marital status, educational level, farm size, amount of credit obtained and cost of inputs significantly and statistically influenced wetland yam production output. Production was majorly constrained by lack of capital, scarcity/high cost of seed yams and pest and diseases infestation. Production could improve if the constraints identified by the study are addressed through the formulation and implementation of sound policies such as the injection of more funds into yam production enterprise and articulated extension delivery system to educate farmers on yam minisett techniques.

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