The Use of Linear Programming Problem To Minimize Fish Feeds

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Abstract— **This research, application of linear programming problem on cost minimization on fish feeds was aimed to minimize the cost of production of fish feeds. The data used was collected using both primary and secondary data. Linear programming problem was used to analyzed the data and the optimum solution was obtained at 5th iterations with fingerlings feeds to be 8/9 of tons and growers feeds to be 10/9 tons and the minimum cost of producing the tones of fingerlings and growers is N498, 675.60. We then recommend that any fish farmer who really wants to embark on efficient and effective fish production should use linear programming problem to determine the minimums cost of production. In other to maximizes their profits.**

Index Terms—**Fish feeds, fish, fingerlings.**

I. INTRODUCTION

1) The complexity of today's business operations, the high cost of technology, materials and labour as well as competitive pressure and the shortened time frame in which many important decision must be made contribute to the difficultly of making effective decisions. All this question are very difficult to answer because it depends on so many different economic, social and political factors and view point, very few business decisions are made which are not primarily based on quantitative measures of some nature. It must be emphasized however that, timely and competent decision analysis should be an aid to the decision makers judgment, not a substitute for it.

2) Historically, fish farming in Nigeria dates back to 1944 when it started as a means of accelerating fish production. The first modern fish farm was built in 1954 in panyam; Plateau State.

3) Today, over 10,000,000 private and government owned fish farms exist in different part of the country. Imerbore and Adesulum (1980) claimed that at present, fish culture has not been very successful due to manpower shortage for design, construction and management of ponds and inadequate supply of fish, fingerlings and cheap suitable fish ponds.

4) Despite the fact that large scale commercial fish farming appears to be the only hope for meeting demand for fish in Nigeria, there are some notable constraint to a viable aquaculture development, such problems include lack of adequate formulated diet for reasonable price and high nutrition value.

5) The basis of aquaculture development lies in fingerlings production and formulation of cheaper and efficient fish feds to produce fish at minimum cost hence the problem of fish feeds development needs special attention for the sustenance of fish farm

6) ALGORITHMS FOR SIMPLEX METHOD

Step I: If the problem is of minimization, convert it to maximization problem by multiplying the objective function z by (-1).

Step II: See that all b_i 's, multiply it by (-1) to make b_i positive.

Step III: Convert all the inequalities to equalities by addition of a slack variables artificial variables or by subtraction of surplus variables as the case may be.

Step IV: Find the starting basic feasible solution.

Step V: Construct the starting simplex table

Step VI: Testing for the optimality of basic feasible solution by computing $z_j - c_j$ if $z_j - c_j > 0$, the solution is optimal, otherwise, we proceed to the next step.

Step VII: To improve on the basic feasible solution we find the IN-COMING VECTOR entering the basic matrix and the OUT-GOING VECTOR to be removed from the basic matrix. The reviable that corresponds to the most negative $z_j - c_j$ is the IN-COMING VECTOR . while the variable that corresponds to the minimum ratio b_i / a_j for a particular j and $a_{ij} > 0$ is the OUT-GOING VECTOR.

Step VIII: the KEY ELEMENT or the pivot element is determined by considering the intersection between the arrows that correspond to both the in-coming and the out-going vectors. The key element is used to generate the next table in the next table, the pivot element will be replaced by zero. To calculate the new values for all other elements in the remaining rows of the pivot column we use the relatin:

New row = former element in the old row – (intersectional element of the old row) x (corresponding element of replacing row).

In this way we get the improved

Step IX: test this new basic feasible solution not optimal, repeat the process till optimal solution is obtained.

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II. METHODOLOGY OF L.P.P FORMULATION

The general linear programming problem can be presented in a tabular form as show below.

INGREDIENT	X1	X2---	XN	SOLUTION (DI)
1	a11	a12	a1n	b1
2 ! !	a12 ! !	a22 ! !	a2n ! !	b2 ! !
M	am1	Am2---	Amn	Bm
Cost (N)	c1	C2---	Cn	

The above table can be interpreted in the below form.

Optimize $z = cx_i + C_2 \text{ x } C_2 + \text{----} \; Cn \text{ x } n$ ------ (i)

St $a_{ii}\ x_i + a_{22}X_2 + \text{-----}\ a_{in}Xn * bi$

$a_{2i}\ x_i + a_{22}X_2 + \text{-----}\ a_{2n}Xn * b_2$

$a_{3i}\ x_i + a_{32}X_2 + \text{-----}\ a_{3n}Xn * b_3$ ....(ii)

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$a_{mi}\ x_i + a_{m2}X_2 + \text{-----}\ a_{mn}Xn * bm$

X_i, X_2, X_3 ----- $Xn > 0$ -------- (iii)

Where $*$ means = <> and (m<n).

III. PRESENTATION OF DATA

(a) In other to complete the minimization in fish feeds, the following data were collected

TABLE I

THE PROPORTION OF THE INGREDIENT REQUIRED TO MAKE A TONNE OF FINISHED TILAPIA – FINGERLINGS FEEDS.

INGREDIENT	(C/O) PER TONNE	QUALITY KG	COST (₦)
Soya	50%	500kg	168600
Blood meal	30%	300kg	51200
Salt	0.5%	5kg	720
Vitamin remix	9.5%	95kg	19000
Bone meal	10%	100kg	12000

TABLE II

THE PROPORTION OF THE INGREDIENTS REQUIRED TO MAKE TONNE OF FINISHING TILAPIA – GROWERS FEEDS

INGREDIENT	(C/O) PER TONNE	QUALITY KG	COST (₦)
Soya meal	30%	300kg	56200
Blood meal	11%	110kg	28160
Salt	0.5%	5kg	720
Vitamin remix	9.5%	95kg	19000
Bone meal	19%	190kg	228000
Maize	30%	300	94000

TABLE III

AVAILABLE INGREDIENT TO PRODUCE A TONNE EACH OF BOTH FINGERLING AND GROWER TILAPIA FEEDS

INGREDIENT	MAXIMUM AVAILABLE	COST ₦
Soya meal	1000kg	281000
Blood meal	1000kg	8533.330
Salt	10kg	1440
Vitamin premix	250kg	500000
Bone meal	300kg	36000
Maize	500kg	117500

TABLE IV

THE QUANTITY OF FINISHED INGREDIENTS REQUIRED TO MAKE FEEDS OF TILAPIA FINGERLINGS (A) AND GROWERS (B) FISH

INGREDIENT	FINGERLING (A)	GROWERS (B)	THE AVAILABILITY INGREDIENT
Soya meal	500kg	200kg	1000kg
Blood meal	300kg	110kg	1000/3kg
Salt	5kg	5kg	10kg
Vitamin remix	95kg	95kg	250kg
Bone meal	100kg	190kg	300kg
Maize	-	400kg	300kg
Cost	₦ 251, 520	₦ 22, 0880	

The data collected for this research is based mainly on both primary and secondary source. The types of ingredients which made up the ration is attracted ingredients which is determined through the market survey. Also, the officers in charge of the fishing was also interviewed on the ways and the proportion with which the ingredients is being mixed. The data used for this research is obtain from Federal ministries of Agriculture Fisheries Department Ilorin.

DATA ANALYSIS

From table iv

Let fingerlings feeds = Xi

Let growers feeds = X_2

Objective function

Minz = 251, 520 Xi + 220, 880 X_2

THE CONSTRAINTS

For Soya meal: $500Xi + 300X_2 \leq 1000$

For blood meal: $200Xi + 110X_2 \leq 1000/3$

For salts: $5Xi + 5X_2 = 10$

For vitamin premix: $95Xi + 95X_2 \leq 250$

For bone meal: $100Xi + 190X_2 \leq 300$

For maize: $0Xi + 400X_2 \leq 500$

$Xi, X_2 \geq 0$

The linear programing problem

$Minz = 251520Xi + 220880X_2$

s.t. $600Xi + 200\ X_2 \leq 1000$

$200X_1 + 110\ X_2 \leq 1000/_3$

$5X_1 + 5X_2 \leq 10$

$95X_1 + 95X_2 \leq 250$

$100X_1 + 190X_2 \leq 250$

$0X_1 + 400X_2 \leq 500$

$X_1 + X_2 = \geq 0.$

By adding the slack variable to change the inequalities to equalities, the equations become.

$$\text{Min } z = 252520\, X_1 + 220880\, X_2$$

$$S.t\ \ 600X_1 + 200X_2 + X_3 = 1000$$

$$200X_1 + 110X_2 + X_4 = 1000/_3$$

$$5X_1 + 5X_2 = 10$$

$$95X_1 + 95X_2 = 200$$

$$100X_1 + 190X_2 + X_6 = 300$$

$$0X_1 + 400X_2 + X_7 = 500$$

$$X_1, X_2, X_3, X_4, X_5, X_6, X_7 >/ 0.$$

Since the problem is minimization, we multiply the objective function by – 1 to charge the problem to maximization and z will change to z^1

$$Max\ z^1 = -1251520X_1 - 220880X_2$$

$$s.t\ \ 500X_1 + 300X_2 + X_3 = 1000$$

$$200X_1 + 110X_2 + X_4 = 1000/_3$$

$$5X_1 + 5X_2 + X_8 = 10$$

$$95X_1 + 95X_2 + X_5 = 250$$

$$100X_1 + 190X_2 + X_6 = 300$$

$$0X_1 + 400\, X_2 + X_7 = 500$$

$$X \geq 0.$$

Result of objective function in each iteration.

Iteration	***Objective Value***
0	0
1	₦3, 00 0000
2	₦1, 40,11,00
3	₦62, 0,80 0
4	₦468, 995.60
5	₦498, 675.60

Hence the cost has bein minimized when the objective function is ₦498, 675.60 with $X_1 = {}^8/_9\ X_2 = {}^{10}/_9$.

IV. CONCLUSION

From the analysis the cost of production was reduced to ₦498, 675.60 in the 5th iteration and it is noted that $^8/_9$ of a ton of fingerlings feeds was produced while the production level for growers feeds increase to $^{10}/_9$ of a ton. By reducing. The cost of feeding to the minima, there will be a total increase in the profit for the fish farmers

RECOMMENDATION

We thereby recommended for any fish farmer who really want to embark on efficient and effective fish. Production to use linear programming problem .

It can also be recommended to any company engaged on the product –mix in order to minimized the total cost of product and to increase the profit margin of their product.

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