

# Allocating Resources to Minimize the Total Cost of Chicken Fodder Factory

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**Abstract**— A chicken factory engaged in producing three types of products: Broiler Fodder, Breeder and Layer Fodder. The management of the factory wants to minimize the cost of the production. The total demand is 26,660 bag/day and Each product is shipped in a (45 kg) bag. The current total cost of producing these products is \$7403/day. Linear programming was used to optimize the allocation of the resources at the factory and minimize the total cost of production to \$3737.28/day.

**Index Terms**— Linear Programing, Optimization, Cost Minimization, Resource Allocation, Optimal Decision, Objective Function.

## 1 PROBLEM STATEMENT

Chicken Factory engaged in producing three types of products: Broiler Fodder (eatable chicken), Breeder Fodder (for the chicken who will lay on the Eggs) and Layer Fodder (for the chicken who make Eggs). The management of the factory wants to minimize the cost of the production. The total demand is 26,660 bag/day.

Each type is shipped in a (45 kg) bag and the ingredients necessary for each type in tons are shown below plus the cost of the ingredients and the maximum Inventory:

Ingredients	Broiler ( ton )	Breeder ( ton )	Layer ( ton )	Max. Inventory (ton)	Cost per (ton) (USD)
Maize	0.02718	0.02718	0.02718	1450	430
Soya	0.01256	0.01256	0.01256	670	600
Oil of Maize	0.00029	0.00029	0.00029	16	13000
Lime Stone	0.00119	0.00119	0.00119	64	40
Lime Stone Coarse	0.0000375	0.0000375	0.0000375	4	40
Oyster Shell	0.0000375	0.0000375	0.0000375	4	600
Calcium Phosphate	0.0006374	0.0006374	0.0006374	34	1600
Vitamin C	0.0000022	0.0000022	0.0000022	0.122	7000
Vitamin E	0.0000006	0.0000006	0.0000006	0.03	100000
Broiler Vitamin	0.00057	0	0	0.870	15000
Breeder Vitamin	0	0.000570	0	0.210	12000
Layer Vitamin	0	0	0.000570	0.190	11000
Broiler Mineral	0.0005927	0	0	0.870	7000
Breeder Mineral	0	0.000592	0	0.210	9000
Layer Mineral	0	0	0.000592	0.190	5000
Salt	0.0001932	0.0001932	0.0001932	10.3	93.33
Wheat Bran	0.0008628	0.0008628	0.0008628	46	600
Mono Calcium	0.0005627	0.0005627	0.0005627	30	1400
Cholin chl.	0.0000251	0.0000251	0.0000251	1.34	1600
Demand (ton/day)		26,660		--	--
Cost of one empty bag (USD)	0.19466	0.19466	0.19466	--	--
Cost of ingredients in one bag(45 kg) (USD)	0.0000355	0.0000350	0.0000321	--	--
Total Cost of one full bag (USD)	0.1946955	0.1946950	0.194692	--	--

As shown on the table above, the amount of ingredients is the same in all the products except in the Vitamins & Minerals. Furthermore, the Maize and the soya are the most important ingredients.

## 2 ANALYZING THE PROBLEM

### 2.1 Broiler Fodder Cost

All the 3 products differ in the Vitamins & Minerals ingredients. The Broiler Fodder ingredients in one bag contains the Maize, Soya, Oil of Maize, Lime Stone, Lime Stone Course, Oyster Shell, Calcium Phosphate, Vitamin C, Vitamin E, Broiler Vitamin, Broiler Mineral, Salt, Wheat Bran, Mono Calcium and Cholin chl. Cost of Broiler Fodder ingredients = amount of each Ingredient in one bag \* Cost of each Ingredient.

Ingredients	Ingredients of 1 Broiler bag ( ton )	Cost per (ton) (USD)	Cost of Ingredients in 1 bag (USD)
Maize	0.02718	0.00043	1.16874E-05
Soya	0.01256	0.0006	0.000007536
Oil of Maize	0.00029	0.003466	1.00514E-06
Lime Stone	0.00119	0.00004	4.76E-08
Lime Stone Coarse	0.0000375	0.00004	1.5E-09
Oyster Shell	0.0000375	0.0006	2.25E-08
Calcium Phosphate	0.0006374	0.0016	1.01984E-06
Vitamin C	0.0000022	0.07	0.00000154
Vitamin E	0.0000006	0.1	0.00000006
Broiler Vitamin	0.00057	0.015	0.00000855
Broiler Mineral	0.0005927	0.007	4.1489E-06
Salt	0.0001932	0.0000933	1.80256E-08
Wheat Bran	0.0008628	0.0006	5.1768E-07
Mono Calcium	0.0005627	0.0014	7.8778E-07
Cholin chl.	0.0000251	0.0016	4.016E-08
Total			0.0000355

Total cost of one bag of Broiler Fodder = cost of ingredients + cost of one bag = 0.0000355 + 0.19466 = \$0.1946955 /bag

### 2.2 Breeder Fodder Cost

All the 3 products differ in the Vitamins & Minerals ingredients. The Broiler Fodder ingredients in one bag contains the Maize, Soya, Oil of Maize, Lime Stone, Lime Stone Course, Oyster Shell, Calcium Phosphate, Vitamin C, Vitamin E, Broiler Vitamin, Broiler Mineral, Salt, Wheat Bran, Mono Calcium and Cholin chl. Cost of Broiler Fodder ingredients = amount of each Ingredient in one bag \* Cost of each Ingredient.

Ingredients	Ingredients of 1 Breeder bag (ton)	Cost per (ton) (USD)	Cost of Ingredients in 1 bag (USD)
Maize	0.02718	0.00043	1.16874E-05
Soya	0.01256	0.0006	0.000007536
Oil of Maize	0.00029	0.003466	1.00514E-06
Lime Stone	0.00119	0.00004	4.76E-08
Lime Stone Coarse	0.0000375	0.00004	1.5E-09
Oyster Shell	0.0000375	0.0006	2.25E-08
Calcium Phosphate	0.0006374	0.0016	1.01984E-06
Vitamin C	0.0000022	0.07	0.000000154
Vitamin E	0.0000006	0.1	0.00000006
Breeder Vitamin	0.000570	0.012	0.00000684
Breeder Mineral	0.000592	0.009	0.000005328
Salt	0.0001932	0.0000933	1.80256E-08
Wheat Bran	0.0008628	0.0006	5.1768E-07
Mono Calcium	0.0005627	0.0014	7.8778E-07
Cholin chl.	0.0000251	0.0016	4.016E-08
Total			0.0000350

Total cost of one bag of Breeder Fodder = cost of ingredients + cost of one bag = 0.0000350 + 0.19466 = \$ 0.1946950 /bag

### 2.3 Layer Fodder Cost

All the 3 products differ in the Vitamins & Minerals ingredients. The Broiler Fodder ingredients in one bag contains the Maize, Soya, Oil of Maize, Lime Stone, Lime Stone Coarse, Oyster Shell, Calcium Phosphate, Vitamin C, Vitamin E, Broiler Vitamin, Broiler Mineral, Salt, Wheat Bran, Mono Calcium and Cholin chl. Cost of Broiler Fodder ingredients = amount of each Ingredient in one bag \* Cost of each Ingredient.

Ingredients	Ingredients of 1 Layer bag (kg)	Cost per (kg) (USD)	Cost of Ingredients in 1 bag (USD)
Maize	0.02718	0.00043	1.16874E-05
Soya	0.01256	0.0006	0.000007536
Oil of Maize	0.00029	0.003466	1.00514E-06
Lime Stone	0.00119	0.00004	4.76E-08
Lime Stone Coarse	0.0000375	0.00004	1.5E-09
Oyster Shell	0.0000375	0.0006	2.25E-08
Calcium Phosphate	0.0006374	0.0016	1.01984E-06
Vitamin C	0.0000022	0.07	0.000000154
Vitamin E	0.0000006	0.1	0.00000006
Layer Vitamin	0.000570	0.011	0.00000627
Layer Mineral	0.000592	0.005	0.00000296
Salt	0.0001932	0.0000933	1.80256E-08
Wheat Bran	0.0008628	0.0006	5.1768E-07
Mono Calcium	0.0005627	0.0014	7.8778E-07
Cholin chl.	0.0000251	0.0016	4.016E-08
Total			0.0000321

Total cost of one bag of Layer Fodder = cost of ingredients + cost of one bag = 0.0000321 + 0.19466 = \$ 0.194692 /bag

### 2.4 Decision Variables

The decision variables chosen were the number of bags of Broiler foddors, number of bags of Breeder foddors and number of bags of Layer foddors.

X1= # of bags of Broiler Foddors to be produced per day.  
X2= # of bags of Breeder Foddors to be produced per day.

X3= # of bags of Layer Foddors to be produced per day.  
The objective function aims at minimizing the cost of production per day (16 working hours). A summary of each product total cost is shown below along with the objective function and constraints.

Total cost of 1 bag of Broiler Fodder = cost of ingredients + cost of one bag = 0.0000355 + 0.19466 = \$ 0.1946955 /bag

Total cost of 1 bag of Breeder Fodder = cost of ingredients + cost of one bag = 0.0000350 + 0.19466 = \$ 0.1946950 /bag

Total cost of 1 bag of Layer Fodder = cost of ingredients + cost of one bag = 0.0000321 + 0.19466 = \$ 0.194692 /bag

Minimize Z = 16 (0.1946955 X1 + 0.1946950 X2 + 0.194692 X3)

With a total of 19 constraints to production of the company's chicken fodder production.

Maize	0.02718 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 1450
Soya	0.01256 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 670
Oil of Maize	0.00029 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 16
Lime Stone	1.1999997 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 64
Lime Stone Coarse	0.0000375 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 4
Oyster Shell	0.0000375 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 4
Calcium Phosphate	0.0006374 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 34
Vitamin C	0.0000022 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 0.122
Vitamin E	0.0000006 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 0.03
Broiler Vitamin	0.00057 X <sub>1</sub>	≤ 0.870
Breeder Vitamin	0.000592 X <sub>2</sub>	≤ 0.210
Layer Vitamin	0.000570 X <sub>3</sub>	≤ 0.190
Broiler Mineral	0.0005927 X <sub>1</sub>	≤ 0.870
Breeder Mineral	0.5927900 X <sub>2</sub>	≤ 0.210
Layer Mineral	0.000592 X <sub>3</sub>	≤ 0.190
Salt	0.0001932 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 10.3
Wheat Bran	0.0008628 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 46
Mono Calcium	0.0005627 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 30
Cholin chl.	0.0000251 (X <sub>1</sub> + X <sub>2</sub> + X <sub>3</sub> )	≤ 1.34

Demand was calculated using the following constraint:  
X1 + X2 + X3 ≤ 1199.7 (ton) = 26660 bag

Where 26660 is the total number of bags the production line can handle every day (production capacity).

## 2 SOLVING THE PROBLEM

After using windows QM software, we got the following results:

Z= \$ 3737.28 per day for producing Broiler Foddors and Layer Foddors.

X1 = 19,528 bags of Broiler Foddors.

X2 = 0 bags of Breeder Foddors.

X3 = 7,132 bags of Layer Foddors.

Resource #	Consumption	Remainder	Remainder Amount
1	not consumed totally	yes	s1=1417.392
2	not consumed totally	yes	s2 = 654.9318
3	not consumed totally	yes	s3 = 15.65209
4	not consumed totally	yes	s4 = 62.57236
5	not consumed totally	yes	s5 = 3.955011
6	not consumed totally	yes	s6 = 3.955011
7	not consumed totally	yes	s7 = 33.23531
8	not consumed totally	yes	s8 = 0.1193607
9	not consumed totally	yes	s9 = 0.02930
10	not consumed totally	yes	s10 = 0.3691102
11	not consumed totally	yes	s11 = 0.21
12	not consumed totally	yes	s12 = 0.1045
13	not consumed totally	yes	s13 = 0.45511
14	not consumed totally	yes	s14 = 0.21
15	consumed totally	no	s15 = 0
16	not consumed totally	yes	s16 = 10.06822
17	not consumed totally	yes	s17 = 44.9649
18	not consumed totally	yes	s18 = 29.32493
19	not consumed totally	yes	s19 = 1.309888

Producing 19,528 bags of Broiler foddors and 7,132 bags of Layer foddors will yield a profit of \$3,665.72 for the company.

#### 4 CONCLUSIONS

After taking into consideration all the variables and constraints, the company's objective of minimizing the total cost of producing chicken foddors was met by allocating 19,528 bags of Broiler foddors, 7,132 bags of Layer foddors and zero bags of Breeder Foddors which resulted in a decrease of the total cost from \$7403/day to \$3737.28/day.

#### 5 REFERENCES

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