A GOAL PROGRAMMING MODEL FOR DECISION MAKING IN PRODUCTION PLANNING OF GROUNDNUT EDIBLE OIL

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ABSTRACT

The aim of this paper is to minimize the total production cost within a maximum permitted budget without violating the demand constraints for production planning of edible groundnut oil using supply chain problem . Effort will be put for minimize waste materials and pollution.

Keywords : Goal programming, decision making, edible oil

Introduction : The goal programming theory is very important field of mathematics and management particularly it is more important in the area of intelligent planning and solution analysis.

The goal programming (GP)is an optimization technique which has become a widely used approach in Operations Research . This technique is used to solve large-scale multi-criteria decision-making problems. The GP technique was first used by Charnes and Cooper in 1960s. This solution approach has been extended by Ijiri (1965), Lee (1972), and others. The Goal Programming Method is an improved method for solving multi-objective problems. Goal programming is one of the model which have been developed to deal with the multiple objectives decision-making problems. This model allows taking into account simultaneously many objectives while the decision-making is seeking the best solution from among a set of feasible solutions. The goal programming technique is an analytical framework that a decision maker can use to provide optimal solutions to multiple and conflicting objectives. Goal programming is a special type of technique. This technique uses the simplex method for finding optimum solution of a single dimensional or multi-dimensional objective function with a given set of constraints which are expressed in linear form. Multiple objectives arise in production companies because of several departments with different functions . This paper deals with a supply chain problem involving the production of ground nut edible oil and various by-products. The process includes material sources, the processing mills and the customers.

The goal programming (GP) technique provides an analytical framework that a decision-maker can use to provide optimal solutions to multicriteria and conflicting objectives. The GP and its variants have been applied to wide variety of problems [4] [6]. The use of GP in process industry problems is not new. Krajnc [4] investigates possibilities of attaining zero-waste emissions in case of sugar production. Arthur and Lawrence [1] designed a GP model to develop production and shipping patterns for chemical and pharmaceutical industries.

Zimmermann [7] proposed the first method for solving fuzzy linear programming problems.The model presented in this paper is designed to illustrate how preemptive GP can be used as an aid to solving multicriteria production related problems. The specified goal is to develop a maxmin model as well as a fuzzy goal programming model.

Edible oils constitute an important component of food expenditure in Indian households. Edible oil industry is one of the most important industries of agriculture sector in India. Ground nut kernel contains 50-55% of oil. The oil obtained from the kernel is yellow to greenish yellow in colour with chief constituents of glycerides of oleic and linoleic acids with lesser amounts of the glycerides of palmitic, stearic, arachidic, behenic, and lignoceric acid. The oil is used as a substitute for olive oil and other edible oils, soaps, salad and cooking oil, mayonnaise and margarine. The meal is an important component of feeds for poultry and cattle. The aim of this paper is to minimize the total production cost within a maximum permitted budget without violating the demand constraints for production planning of edible groundnut oil using supply chain problem . Effort will be put for minimize waste materials and pollution.

Following goals are decided:

Goal 1: Minimize total cost

Goal 2 Reduction in level of pollution or the q^{th} mil

Goal 3 Reduction in level of waste

Structure

In order to formulate the model, the following Symbols are used :

(I) Indices:

p: the index of the sources of ground nut

q : the index of the production process

r : the index of the product ground nut

s : the index of the customer groups

Sets:

P : the set of the sources of ground nut

Q : the set of the production process

R : the set of the products

S : the set of the customer groups

(ii) Parameters

u_{rs} = Monthly demand for product type r for customer group s .

C_{pqrs} = Total cost of producing and shipping the r th product type (including raw materials) from the p th ground nut source through the q th milling location to the s th customer group.

t_{pqr} = Unit time to produce a unit of the qth output type at the q th mill.

bq = Production capacity at the q th mill.

qr = Pollution level at the q th mill for the production of a unit of the r th output type (Gallons of water)

Tq = Total Times available on a yearly basis for the q th mill

TC = Total cost

Y_1 = Pollution limit for the r th mill

Tw = Total waste obtained

x_a = Priority labels, where, a is 1,2,3

(iii)Variable

X_{pqrs} = the amount of product type r produced from corn from source p in mill type q for customer group s .

u_1+= the deviation variable of overachievement of the goal 1

u_1^- = the deviation variable of underachievement of the goal 1

u_2^+ = the deviation variable of overachievement of the goal 2

u_2^- = the deviation variable of underachievement of the goal 2

u_3^+ = the deviation variable of overachievement of the goal 3

u_3^- = the deviation variable of underachievement of the goal 3

(iv) Goal constraints and objective functions

Goal 1: $Z_1 = \sum_{s=1}^{s} \sum_{r=1}^{r} \sum_{q=1}^{q} \sum_{p=1}^{p} C_{pqrs} X_{pqrs} - u_1^+ + u_1^- \leq TC$, $X_{pqrs} \geq 0$ ……….(1)

Goal 2 $Z_2 = \sum_{r=1}^{r} \sum_{q=1}^{q} Y_{qr} x_{pqrs} - u_2^+ + u_2^- \leq YG_q$ for all p = 1 to P and q= 1 to Q ……….(2)

Goal 3 $Z_3 = \sum_{p=1}^{p} \sum_{q=1}^{q} \sum_{s=1}^{s} X_{pqrs} - u_3^+ + u_3^- \leq Tw$ for R = 6 ……..(3)

The objective function for the goal programming model is:

Minimize

$$\mathbf{Z = x_3u_3 + x_2u_2 + x_1u_1}$$ … ………(4)

(v) Constraints

The objective functions formulated in the previous section are restricted by two sets of constraints. They are the demand constraints, and the time constraint.

$\sum_{r=}^{r} \sum_{s=1}^{s} X_{pqrs} \geq u_{rs},$ for all p = 1…….P , q = 1…..Q ………(5)

$\sum_{s=}^{s} \sum_{r=1}^{r} \sum_{p=1}^{p} t_{pqr} x_{pqrs} \leq T_{q,}$ for all q = 1…………Q ………(6)

$X_{pqrs}\, u_1^{+}, u_1^{-}, u_2^{+}, u_2^{-}, u_3^{+}, u_3^{-}, \geq 0$, p ε P, q ε O, r ε R, s ε S , … ……(7)

It is observed that

Constraint (5) ensures that the customer demands are met.
The constraint (6) limits the hours available for processing on each type of milling.
Constraint (7) ensures that all the decision variables are non-negative.

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