EMPLOYMENT OF LINEAR AND NONLINEAR PROGRAMMING IN DESIGNING AND MANAGING AQUACULTURES

By

WALEED MOHAMMED ALI HASAN ALSHORBAGY

B. Sc. Agric. Sc. (Agricultural Engineering), Zagazig University, 2006.

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Linear programming (LP) is a computational method of selecting, allocating and evaluating limited resources with linear, algebraic constraints to obtain an optimal solution for a linear, algebraic objective function. They are used in administrative and economic planning to maximize the linear functions of a large number of variables, subject to certain constraints.

The ability to introduce LP using a graphical approach, the relative ease of the solution method, the widespread availability of LP software packages, and the wide range of applications make LP accessible. Additionally, LP provides an excellent opportunity to introduce the idea of "what-if" analysis, due to the powerful tools for post-optimality analysis developed for the LP model.

LP deals with a class of programming problems where both the objective function to be optimized are linear and all relations among the variables corresponding to resources are linear. This problem was first formulated and solved in the late 1940's.

Today, this theory is being successfully applied to problems of capital budgeting, design of diets, conservation of resources, games of strategy, economic growth prediction, and transportation systems. In very recent times, LP theory has also helped resolve and unify many outstanding applications.

In this thesis, LP is used in aquatic culture in which many of the important water quality parameters are the dissolved gases, such as oxygen, carbon dioxide, hydrogen sulfide, ammonia, and nitrogen. Aeration, or the addition of dissolved oxygen (DO), is one of the processes most commonly used in aquaculture.

1- INTRODUCTION

The maintenance of environmental quality requires control of levels of dissolved gas. The ‘‘best’’ aeration system for a given application depends on site conditions, production schedules, the layout of the rearing units, and operational procedures.

The growth of fish is not affected until the dissolved oxygen (DO) drops below a critical concentration. This critical concentration is influenced by temperature and by feeding level; it ranges from 5 to 6 mg/L (ppm) for salmon and trout (Salmonidae) and from 3 to 4 mg/L (ppm) for warm-water fish such as channel catfish. The use of oxygen supplementation can also increase survival and improve fish health and quality. Some of the beneficial effects of oxygen supplementation may be due to the stripping of chronic levels of gas super saturation.
The design of an aeration system must consider the potential impacts on all the dissolved gases in solution.

In a number of systems, oxygen transfer rate is more important than efficiency. Tractor-powered paddlewheel aerators have been used widely in catfish ponds for emergency aeration and can easily be moved from pond to pond when needed. Diffused aeration with pure oxygen is widely used in transportation systems and in emergency for high-intensity systems, because of its ability to transfer large amounts of oxygen without any power input.

The first phase, in this thesis, is linear programming used to select optimal aeration systems based on minimization of total annual cost using suitable aeration devices for size of pond to give optimum oxygen to that size of pond. The second phase deals with using of linear programming for choosing optimum types of fish (tilapia, cat fish, and mullet) on poly culture, to give high profit with available potential.