Linear Programming Method to Optimize Haditha Dam Performance

Prepared by:

Ali Muntajab I. Al-Ruwayyih

Supervisor:

Asst. Prof. Dr. Tariq J. Al-Musawi

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Isra University
Faculty of Engineering
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا ۖ إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ ﴿٣٢﴾

صَدَق اللّٰه الْعَظِيْم

سورة البقرة ﴿٣٢﴾

Dedication

I dedicate this work to my great **country, Iraq**.

To my **father, mother** and **sisters.**

I also dedicate this thesis to my **lovely wife**,

whose words of motivation and encouragement for tenacity ring in my ears.

I also dedicate this thesis to my **friends** who have supported me throughout this work. I will always appreciate all what they have done for helping me.

In addition, I would like to thank the **Hashemite Kingdom of Jordan** and its people for helping and hosting me throughout the duration of my research.

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Authorization Form

I, Ali Muntajab I. Al-Ruwayyih, authorized Isra University to supply copies of my thesis to libraries, establishments or individuals on request, according to Isra University regulations.

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This thesis titled, " **Linear Programming Method to Optimize Haditha Dam Performance "** was successfully defended and approved by:

Examination Committee **Signature**

Asst. Prof. Dr. Tariq J. Al-Musawi (Supervisor) ----------

Department of Civil Engineering

Faculty of Engineering

Isra University

Assoc. Prof. Dr. Ibrahim A. Mohammad (Member) ----------

Department of Civil Engineering

Faculty of Engineering

Isra University

Assoc. Prof. Dr. Bashar Al-Smadi (Member) ----------

Department of Civil Engineering

School of Engineering

The University of Jordan

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Abstract

Linear Programming Method to Optimize Haditha Dam Performance

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In the present study, the optimization technique in the field of water resource management is presented in detail with the using linear programming. The proposed methodology is applied to manage the water outflow from the dam reservoir. In this context, Haditha dam in Iraq is considered as a case study. At first, the data of Euphrates river inflow, evaporation and precipitation is collected from several recently published studies. Moreover, design parameters of Haditha dam and water demands for downstream area were taken considered in the data collection process. A mathematical model that ensures the determination of optimum water quantity for various requirements is built by utilizing linear programming technique and solved by using a MATLAB program. For this purpose, the collected data is expressed and inputted in the mathematical model in the form of monthly variation. Due to large size of collected data, three hydrological cases were selected based on the total annual, flow including wet, moderate and dry years. The output results were grouped to water demand parameters for both municipal and irrigation uses. Surplus water consists of surplus water from electrical demand and spillway water. The first two result positive profit, while the remaining two result negative profit. Therefore, the objective of the optimization model is to determine the

maximum monthly profit. The water balance equation is used as a constraint in the optimization model for calculating the optimized storage. In the dry year, the storage value in the studied reservoir is near to the critical value; therefore, water consumption for municipal uses should be reduced in order to prevent the water storage level from reaching its minimum limit. If this point is impossible, an additional water resource may be used to substitute the water demand deficit. For many cases, it is found that the initial storage of Haditha dam is an important parameter in the determination of the optimal solution.

Key word: Water management, Reservoir, Dams, Optimization, Linear programming, MATLAB.

Chapter One

Introduction

Chapter One: Introduction

1.1 Background

The availability of water in adequate quantity and safe quality is a very important issue in many areas around the world. In addition, water resource management represents one of the greatest challenges facing us globally in the 21th century. Throughout history, the availability of water played always an important role in the existence and development of numerous civilizations. Nowadays, scientific workers focus their efforts on applying the best management systems of water resources and reservoirs (**Thankachana and Anitha, 2015**). In addition, human beings constructed dams to benefit from retained rainfall water. In this context, **Jury and Vaux (2005)** showed that the era in which the rising demands for water could be contained by only constructing engineering infrastructures such as large dams on rivers seems to be over or nearly over. The construction of dams can be a solution for the critical problem of water scarcity if they are properly managed according to the water uses downstream the dams. Unfortunately, the current applied methods for managing water are not exhibiting the desired results or, in other words, are not efficient. Several points should be identified for successful management of water resources. First, water management methods require comprehensive and precise information on the available resources. Second, the purposes for which dams are constructed should be identified. Finally, the required mechanisms used for taking the policy decisions should be included.

Dams, in all their types, are structures that obstruct river or stream water flow to form reservoirs, by keeping water from flowing downstream. As a result, dams allow people upstream to have preferential use. The construction of dams is not only about the technical aspects related