

ASSESSMENT OF WATER BALANCE APPROACH FOR DIFFERENT
WATER SUPPLY CONDITIONS IN DAHUK DAM

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A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Civil-Hydraulics and Hydrology)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

JUNE 2013

Specially dedicated to my beloved parents and teachers

ACKNOWLEDGEMENT

First of all, I would like to thank Almighty Allah for giving me strength, hope and health to go through all obstacles to complete this research successfully.

With a deep sense of gratitude, I would like to express my sincere thank to my supervisor Dr. Arien Heryansyah who has been offered invaluable assistant advice, guidance, constant support and high level of inspirations for me through the completion of this research. I have learned a lot from him and I am fortunate to have him as my mentor and supervisor.

My sincere appreciation goes to my mother and my wife for them love, support, kindship and care through these trying peroids of my life. My studies also been very hard on them, as we have been far from each other, however, their continuous reassurance and optimisim has helped me a lot in being achieve to the best of my ability.

My gratefulness goes to Mr. Bakhtiyar Ameen, Mr. Bahjat Ali, Mr. Jamil Jassim in General Directorate of Investment – Dahuk office, Mr. Karwan Bamarni in Dahuk Dam office, Mrs. Sondes Salima Solevanay in GDID and my sister Jowan Hussain in Dahuk University.

Acknowledgements would not be complete without thanking to my friends who directly or indirectly have been supporting me to step ahead in life.

ABSTRACT

Dahuk dam system is one of the Kurdistan-Iraq Government strategies to asset water supply. It is the main point for tourism and the only safe source to meet the needs of the city in difficult circumstances of water crisis between the countries of the region, Turkey, Iraq and Syria. In recent years it is observed that the dam is not fulfilling the water requirement of Dahuk city. Therefore water balance calculation of the dam system is needed to evaluate the real water problem. However water balance needs sufficient hydrologic data, which is not available in that region. Generation of sufficient hydrologic data over a long period is necessary before water balance. To ensure that the integrity of the data obtain from different sources, filling the missing data is ascertained, and regression analysis is carried out. Then water balance in Dahuk Dam will be used as an assessment for different conditions by using some scenarios and countermeasures. The Scenario setting is to select the best alternative to dam reservoir survival for mandatory water demand. By using 24 scenarios, it has been shown that the dam was unable to support water demand for irrigation purpose together with domestic water supply and tourism purpose. However by supply water from Khabour River and cancelling the irrigation project, the water level of the reservoir has been enhanced to meet up with the demand for domestic water supply, as shown on Scenario-10. Khabour water contribution should be the program priority to survive the reservoir's goals in case of integrated water resource management at the Dahuk Dam System.

ABSTRAK

Salah satu strategi kerajaan Kurdistan-Iraq untuk membekalkan air adalah Sistem Empangan Dahuk. Dalam beberapa tahun kebelakangan ini, cuaca sentiasa berubah dari basah ke kering, dan kapasiti simpanan air dalam takungan empangan adalah mustahil untuk mendapatkan jumlah air yang diperlukan untuk menampung keperluan penduduk bandar Dahuk. Untuk mengatasi keadaan ini, kerajaan telah memutuskan untuk mengeksploitasi takungan untuk kegunaan bandar, pelancongan, dan domestik dalam Bandar Dahuk, dan dalam masa yang sama membatalkan projek pengairan yang diperlukan. Lembangan Empangan Dahuk adalah satu-satunya sumber yang selamat untuk memenuhi keperluan bandar di dalam keadaan krisis air yang sukar di antara negara-negara di rantau ini seperti Turki, Iraq dan Syria. Oleh itu, sistem empangan pengiraan imbalan air diperlukan, dan kajian imbalan air di empangan Dahuk akan dijalankan. Kajian ini akan digunakan sebagai penilaian untuk keadaan yang berbeza dengan menggunakan beberapa jenis senario. Penubuhan senario adalah untuk memilih alternatif terbaik bagi takungan empangan untuk keperluan air mandatori, peraturan prestasi pada turun naik iklim dan mewujudkan peraturan peruntukan sebagai rancangan sekatan biasa bagi permintaan air minuman, pengairan, pelancongan dan alam sekitar. Dengan menggunakan 24 program dan kes-kes yang berbeza, ia telah menunjukkan bahawa empangan tidak dapat membekalkan air untuk pengairan tanah serta permintaan domestik. Bagaimanapun selepas menukar rancangan untuk membatalkan projek-projek pengairan dan hanya bergantung kepada bekalan air untuk keperluan domestik dengan menjaga paras air yang diperlukan oleh takungan untuk keperluan pelancongan dan mengimbangi kenaikan permintaan, senario dengan sumbangan air Khabour ini perlu mencukupi dan menjadi keutamaan program untuk terus menghidupkan takungan dan dalam masa yang sama menjaga eko-sistem sekitar tasik.

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LIST OF ABBREVIATION

GDID	General Directorate for Irrigation and Dam
DDR	Dahuk Dam's Reservoir
DDC	Dahuk Dam's Catchment
KRC	Khabour River's catchment
AWR-2007	The Aphrodite's Water Resources-2007

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CHAPTER 1

INTRODUCTION

1.1 Background

On the surface of the earth the renewable of fresh water sources becomes irregular and it is limited to distribution in time and space. Despite the natural variation, humans contain to supply water from different locations by collecting it in more reliable and supply in constant range with reduce by various losses like evaporation and consumption. That system is called water storage or reservoir. Various water sources including groundwater, stream flow, rainfall, and/or snow are replaced by reservoir system (Tallaksen, 2004). The aim of water storage is to meet several goals such as reducing the risk of droughts and floods, hydropower, drinking supplies, irrigation, recreation and fishing (UNESCO, 2006). Although reservoirs and dams have the positive effect on more reliable supply as well as negative effects on ecosystem functions (Dynesius and Nilsson, 1994). Therefore a research on water balance are necessary to integrate the function of reservoir system on water supply and ecosystem.

1.2 Study Area

One of the Iraq Government strategies to asset water supply is Dahuk dam system. Geographically, the dam is located at Dahuk city - Kurdistan Region -north

Iraq near the Turkish border. In recent years, climate has changed from wet to dry, and the capacity of water storage in the dam reservoir has decreased, therefore; the quantity of water in dam reservoir is not sufficient for irrigation. As a reason, the government decided to exploit this reservoir for urban uses, touristic, and domestic in Dahuk city, ensue cancelling the must irrigations project.

Since 1993, the Lake of Dahuk dam is one of the main sources of drinking for Dahuk city, in addition to Mosul's dam lake, where water was pumped to Dahuk city. While Turkey started to build numerous dams in Tigris River that flow from Taurus Mountains (Turkey) to Iraq and reaches the Mosul dam (Ohara et al., 2011), as shown in Figure 1.1, the crisis began between the two countries, as a consequence the government understood that it cannot depend on Mosul Lake to reach exigency water to Dahuk city in the future, and it has to think of another solution.



Figure 1.1: Location of Dahuk Dam

The Dahuk River is located approximately 450 km far from Baghdad in Kurdistan Region north Iraq. The lower Dahuk River is regulated by Dahuk Dam 2 km in the north of Dahuk city. It was constructed mainly for supplying water to irrigate 4600 ha of the agriculture area. Other purposes are: Fishing and tourism.

During the 1993 Dahuk Reservoir was also used to supply drinking water to Dahuk City. The dam and catchment's Characteristics are provided in Table 1.1.

Table 1.1: Dahuk Dam and Reservoir characteristics (GDID)

Characteristic	Volume
Full supply level	615.75 masl
Wall height	619.73 masl
Full supply storage capacity	52 MCM
Surface area at full supply	2.560 Million km ²
Crest length	740 m
Reservoir catchment area	135 km ²
Spillway type	Bell-Mouth
Spillway capacity	81 m ³ / sec
Life storage	47.51 MCM
Dead storage	4.39 MCM

Note: MCM is million cubic meter
masl is Meters above sea level

The Dahuk River has two main tributaries, Garmava River and Sindor River as shown in Figure 1.2.



Figure 1.2: Dahuk River catchment

The climate of this location is similar to the climate of Mediterranean and partly to the climate of Iranian region, the weather is characterized by dry hot in Summer and cold rainy in Winter with snow falls on the high mountains (Anderson et al., 2008). Mainly rainstorms occur from 15th October to 15th May while other times of the year are dry. The amplitude varies between winter and summer temperature is high. The annual mean temperature is 19.5 °C (Shawkat, 2007). Table 1.2 shows the climatological information of the region, obtained from metrological office - Dahuk city. The hydrologic data (1986-2001) was lost due to civil war, so it is not allowed to consider short period in evaluating the hydrological system even find information for longer duration. Additional note, the quality of water and the soil degradation problems of its natural resources and effectives living conditions of the settled villages in the area will not be consider in research.

Table 1.2: Climatological information of Dahuk City (Shawkat, 2007)

Month	Average Temp		Rainfall (mm)
	Max	Min	
January	12.2	4.4	94.96
February	13.2	3.86	91.05
March	15.8	0.91	89.28
April	22.3	11.21	57.79
May	30.9	17.69	26.2
June	36.2	21.73	1.01
July	29.7	24.63	0
August	39.13	23.68	0
September	24.46	20.85	0
October	27.46	15.86	20.73
November	18.73	9.61	63.74
December	12.48	4.46	90.24
Avareage	25.21	13.74	44.58

Geologically, the south of the area is bounded by the White Mountain and the north by Zakho Mountain as shown in Figure 1.3. The structure of the area involves deposits of the Eocene which are represented by a number of formations: slightly dolomite limestone, an alternative of dolomite marls, gypsum rocks, alternative of

clay marls, clay limestone, polemicist sandstone and Fragmental Detritus (small rock fragments) (Mohammed, 2010).



Figure 1.3: Location of Dahuk Reservoir

1.3 Problem Statement

The problem of Dahuk reservoir is, the impossibility of getting the needed amount of water to cover the need of Dahuk city, or continue to maintain aesthetic area for touristic purposes, due to the decrease in rainfall, increase of temperatures, and the constant expansion in the area of the city, while The Basin of Dahuk dam was the only safe source to meet the needs of the city in difficult circumstances of water crisis between the countries of the region, Turkey, Iraq and Syria. Therefore, the water balance calculation of the dam system is needed, and researches of water balance in Dahuk dam will be conducted to be used as an assessment for different conditions, But due to the effect of climate change and the potential growth in population which may not be the best solution, so increase of water supply by additional sources, such as the Khabour River (Figure 1.1), have to be considered to

reach the expansion in demand from project by using some scenario and countermeasures. However, more infrastructures are required to assist the process of bringing water, like improving the water quantity in this source. Hence, better considerations for Dahuk Reservoir water balance tend to manage the best available program and Scenarios.

1.4 Study Objectives

To achieve this evaluation the following objectives are targeted:

- 1- To generate sufficient hydrologic data for the Dahuk dam.
- 2- To identify the exemplary water balance for water supply scheme in the Dahuk dam.
- 3- To select potential program for the integrated water resource management at the Dahuk dam system.

1.5 Scope of Study

This paper intends to study:

- 1- The emphasis on the selection of a suitable Scenarios program, and specification in water balance problem for Dahuk reservoir.
- 2- The sensitivity of fluctuation in the uses of water consumption motivated, which helps in the ranking the Scenarios program.
- 3- The advantage of the selected Scenario program in proper balancing process insensitive resolutions related to conditions of natural water resources which is a parameter for future evaluation in this area.

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