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Thesis Approval

Quantifying The Surface Water Runoff To The Dead Sea Under Different Climate Scenarios, Case Study WadiArugut Catchment.

Prepared by: Husam Bassam Yousef Utair

Registration No: 20913859

Supervisor: Dr. Amer Marei

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The names and signatures of the examining committee members are as follows:

1-Head of Committee: Dr. Amer Marei Signature: .....

2-Internal Examiner: Dr. Amer Kanan Signature: .....

3-External Examiner: Dr. Sa'ed Khayat Signature: .....

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Abstract

The surrounded area of the Dead Sea, especially the west side suffers from many hydrological problems. While the Dead Sea level drop is considered a major problem that affects the quality of the surrounding fresh water resources. A lot of the surface water floods from the adjacent wadi are lost through direct run off without any exploitation. Therefore, it is necessary to maintain a type of balance between surface water exploitation through the wadi and at the same time allow a sufficient amount of flow to the Dead Sea to ensure its sustainability. In this study a model was built using both WMS and HEC-HMS programs. These programs were applied for one of the large tributary in the western side of the Dead Sea basin. The WMS-Watershed modeling system was used as a moderator program for the HEC-HMS programs. The HEC-HMS program was used for computation and simulation of storm-flow hydrographs. The stream was modeled for runoff response to different rainfall amount and climate conditions (dry, normal, and wet seasons) which were chosen from the rainy seasons in the previous 30 years. Finally the amounts of surface water contribution from each of the 3 scenarios to the Dead Sea were quantified. These surface water modeling programs were used, in order to assess the surface water contribution and the role of recharge excess to the Dead Sea. The modeled data shows that such events normally contribute with about 18-22 MCM annually to the Dead Sea. The percentage of surface runoff was still the same in three different scenarios as 40%. Moreover, 50% less precipitation in 2006 decreases the Dead Sea level by 5 meters within 5 years, and 60% in 1992 increase of precipitation raises the water level 2 meter only for the 2-3 following years. How can we balance the groundwater needs and the Dead Sea survival with those 40 % surface water? These conclusions suggest strongly the need of integrated groundwater model is to be applied for all streams in the region, in order to quantify all Scenarios, and Make studies about the dams on tributaries of the Jordan River in the eastern side of Jordan River and its impact on the Dead Sea.

تحديد كمية مياه الجريان السطحي إلى البحر الميت تحت سيناريوهات مناخية مختلفة (دراسة حالة منطقة التجميع لواد أرجوت)

إعداد: حسام بسام يوسف عطير.

المشرف: د. عامر مرعي.

الملخص:

تعاني منطقة البحر الميت العديد من المشاكل الهيدرولوجية، وتعتبر مشكلة تراجع مستوى سطح البحر الميت من أهم هذه المشاكل والتي تؤثر على نوعية المياه في المنطقة جميعها، على الرغم من أن هناك كميات ضخمة غير مستغلة من المياه تصل إلى البحر الميت من خلال الأودية المحيطة به، لذلك هناك حاجة لعمل موازنة مائية للمنطقة بحيث يتم حساب تلك الكميات وتقدير أثرها وأهميتها على البحر الميت.

وتعد هذه دراسة عملية وتطبيقية، حيث استخدم فيها برنامج (WMS) وبرنامج (HMS-HES) وذلك لعمل الموازنة المائية وتم اختيار منطقة الدراسة لتشمل احد اكبر الأودية التي تسير باتجاه البحر الميت. لعمل موازنة مائية دقيقة كان لا بد من المقارنة بين ظروف مختلفة لذا تم اختيار 3 سيناريوهات لتشمل جميع الحالات المطرية (سنة جافة، سنة مطرية، سنة ضمن المعدل العام).

أظهرت النتائج بان كمية المياه التي تصل إلى البحر الميت تشكل 40% من كمية الأمطار المتساقطة في السنة بالرغم من اختلاف الظروف المطرية، حيث بلغت تلك الكمية 18-22 مليون متر مكعب في المعدل العام، كما أظهرت النتائج بأنه هناك تأثير لتلك الكميات على مستوى سطح البحر ولكن بشكل محدود.

وأثارت هذه النتائج العديد من التساؤلات حول مدى أهمية هذه الكميات على البحر الميت، لذلك ظهرت حاجة لعمل دراسة تقيم متكاملة لجميع الأودية الواصلة إلى البحر الميت، وعمل دراسات أوسع حول السدود التي أقيمت على الجانب الشرقي من البحر الميت؛ لمعرفة مدى تأثيرها على نهر الأردن، لأنه المغذي الرئيس للبحر الميت.

Chapter one:

Introduction:

1.1 Introduction

"Water is life" this proverb has been used for many centauries all over the world. It is known that without water, no form of life can exist. That is why water is an essential assent and the utmost important natural resource for the Palestinian people. To the contrary of people's common knowledge, the West Bank in general is not considered to be a water-poor region, since the fresh groundwater resources are estimated to be approximately 669 MCM/yr and runoff water of about 215MCM (PWA, 2010).

The average daily Palestinian consumption of water is 60L/c/d (Issaq, 2009) and 65 L/c/d (PWA, 2010). In 2009 the abstraction of 94 MCM was done, out of which 50 MCM are used for agriculture irrigating around 90,000 dunums of land while 44 MCM are for domestic and industrial use. An additional 54 MCM was purchased from the Israeli National Water Company (Mekorot) a significant percentage of this volume is extracted from wells related to MekorotCompany in the West Bank. Hence, the total water quantities utilized by Palestinians are calculated at 148 MCM. Moreover, water losses in the West Bank exceed 35%. Thus the real net amount used is about 98MCM (PHG, 2005). Over the whole WB some of the most water-deficit areas are in the rural south and south-west region of the Hebron governorate; it has very limited amounts of water (Isaac, 2009).

There are a lot of tributaries and wadis streams that runs through the eastern slope to the Jordan River and Dead Sea. These streams are seasonally generate a huge amount of surface runoff that were roughly estimated by Roff and Rafti 1956 as 40% of the total amount of the precipitation over the catchment areas, mainly, in the upper mountains. The precipitation rate over the mountain areas varied between 400-700mm/year. However, these amounts are seasonally fluctuated in the recent 30 years with frequent dry seasons. On the other hand, most of the Wadis run off drained directly and through Jordan River to the Dead Sea area. Those seasonal streams play the main role in the Dead Sea sustainability and mitigate the hazardous effects of the sea level drop that were mentioned in many previous studies (Khayat et al, 2006; Salameh, 2000; Vengosh an Rosenthal, 1994; Gavrielli, and Bein, 2006; Al-Weshah, 2000; Salameh and El-Naser, 2000). Thus one of the large tributaries that directly drained to the Dead Sea, called Wadi Arogut, was chosen to conduct a flood simulation model, and compare different climate scenarios and its effect at the Dead Sea fluctuation during the last 4 decades.

1.2 Problem Statement:

A lot of dams were built in the eastern side and decrease the discharge of Jordan river which is the main reason for stability of the dead sea. A large amount of surface water goes directly to the Dead Sea without exploitation and a large part of which is lost in form of evaporation. (Issac - ARIJ, 2009).Hebron governorate considered as most arid part of the West Bank and more population with low water resources used, The lack of water and the short rainy season are the main problems facing Hebron in general and the study area in particular, where many of the communities in resistance spot suffers from a significant lack of water quantity especially in the summer, forcing them to use external sources

1.3 Justifications:

The amount of water moving in the streams very large and unexploited so it is necessary to calculate these quantities and find a way to harvest it, those seasonal streams play the main role in the Dead Sea sustainability and mitigate the hazardous effects of the sea level drop

1.4 Objectives:

- The main objective of this study is to quantify the amount of surface runoff goes directly to the Dead Sea.
- Built a HEC-HMS model depending on hydrological data in three different scenarios (average, wet and dry year).

1.5 Questions:

The main question that I try to solve it are:

- How can people harvest the surface water to meet the water shortage in the region, and at the same time prevent more degradations to the Dead Sea level drop?
- How effective the surface water contribute the Dead Sea in the mean of quantity?
- How this quantity varied under different scenarios of climate conditions for the previous 40 years?

1.6 Hypothesis:

- The amount of water losses in the upper part of study area varied between 50 to 60 % according to the built-up area and the vegetation cover.
- The amount of water losses in the lower part less than 40 % according to the higher slope and type of outcrop geology .

1.7 Limitations:

There is a lot of obstacles in study area but the main one that it's difficult to distribute the instruments in all of the area because of military closed areas in some places at the lower part of study area .

5.6 Conclusion

Finds no clear impact of climate changes on the declining level of the surface of the Dead Sea, in the rainy season 1991/1992 there was a higher amount of rainfall over the study area that reaches around 155 MCM. Despite the presence of this high amount the percentage of discharge still the same. This mean that the increase in recharge accompanied by increase in losses as inundation, the high amount of rain increase the amount of inundated surface water out of the Wadi banks and covers more surfaces all over the study area.

Moreover, 50% less precipitation in 2006 decrease the Dead Sea 5 meters within 5 years, and 60% 1992 increase of precipitation raise the water level 2 meter only for 2-3 next years. All of these results suggest strongly the problem of Dead Sea drop with the common surrounded groundwater Stalinization problem. If the increase of the surface runoff to the Dead Sea can maintain the Dead Sea level and consequently prevent the deterioration of surrounded water resources. How can we balance the groundwater needs and the Dead Sea survival with those 40 % surface water? Providing that, if that 40% surface water runoff increase, it will be increases into the account of groundwater recharge. By no mean: preventing the Dead Sea decline by increasing runoff will not only preventing the fresh water deterioration, but also it will be into the account of groundwater recharge in the surrounding aquifers of the Dead Sea.

All of these conclusions suggest strongly the need of integrated groundwater model, in order to understand the main reason of dead sea falling quantify both Scenarios, and enhancing a sort of hydrological balance where a sufficient amount of surface water contribution to the Dead Sea can be provided without affecting the groundwater level or amount of groundwater recharge.

5.7 Recommendations

The researchers recommends:-

- To apply this study to the entire eastern basin to quantify the amount of discharge to the Jordan valley and therefore to the Dead Sea.
- Make studies about the dams on tributaries of the Jordan River in the eastern side of Jordan River and its impact on the Dead Sea.
- Make studies about how taking benefits from the water resources can affect the water table on the Dead Sea.
- Make studies about how taking benefits from the water resources can affects on ground water.