# Effect of Sarni Dam and Construction of ZaraniDam on Organization of Mazabi River in Hormozgan Province

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**Abstract**

The construction of multi-purpose flood dam control systems has been one of the ways to reduce flood damage. The Previous research has shown that the construction of the dam has led to significant changes in the hydraulic flow regime in the down stream. In this research, the effect of constructing the Serni and Zarani dams on the Masazbi River in the Jomahale interval located Hormozgan province has been investigated using the HEC-RAS 2D. The results of the considerations show that in the scenario of dams construction, significant changes occur in the flow range in the flood plain, while the change in hydraulic parameters within the main channel range is negligible.

**Keywords**:Mazabiriver,Sarnei dam, Zerani dam, HEC-RAS 2D

## INTRODUCTION

In Iran, the geographical position, the rainfall and the physical conditions of the basins cause severe floods, with the consequent increasing damages. Although our country is located in arid regions, the volume of several days of floods in some rivers is equivalent to the average annual flooding of the rivers. Of course, in most cases, the volume of floods for a hundred years is small compared to the volume of dams being built or under construction, so using active management, seasonal characteristics and short- and long-term hydrological forecasts, the use of reservoirs for flood storage. It is easily possible.

River regeneration is one of the most expanded branches of river engineering that is more widely used than other branches of science.

And for greater human control over the river and its behavior, including various purposes such as flood control, creating safe and secure conditions for navigation, sediment containment, bed erosion control, as well as diversion, conveyance and stream water management. It is a clear and desirable path. The projects of the last 100 years, and especially the present ones, have been a major focus of river engineering work on streamlining and environmental development [1].Knowing the conditions of each river is important in planning water resources, constructing hydraulic structures, and securing the cost of the various sections. One of these studies is the recognition of river flow regime conditions which can be an appropriate criterion for assessing the river flow best. Recognizing a river alone and considering its natural conditions is very important. It is now possible to realize the double importance of this river when the conditions of a river go out of its natural state and undergo abnormal changes. These changes are due to large hydraulic structures such as large dams. The dams have in fact transformed the natural flow of the river into a regulating stream and caused extensive changes in the river's hydraulic parameters. In other words, with the construction of large hydraulic structures such as reservoir dams, the underlying conditions of the river have double changes, especially downstream of the rivers. Across the globe, the study of the hydraulic regime of rivers before and after dam construction is considered an important position. For example, Sangchwei et al. Investigated the effects of the Hop Chun Dam on the change of the Wanig River flow regime in South Korea. [2].

McGilligan et al. In the United States studied the hydrological regime changes caused by the dam construction on the river. Hydrograph changes at monthly and annual scales are the effects of dam construction. He made comparisons between natural and regulated currents and determined the rate of discharge reduction to be 67% to 90% [3]. Yan et al. Investigated the impact of dam construction on the flow regime downstream of the Yellow River and found that there was a significant decrease in river flow with the Gunung terrain scale [4].Azarang et al. Studied the effects of Karkheh dam construction on the flow conditions and hydraulic parameters of Karkheh River downstream. In this study, a detailed evaluation of the river flow regime change from normal to regular has been done. Also, the percentage of change of hydraulic parameters in different cross sections of Karkheh river was calculated for minimum, average and maximum characteristic discharges before and after dam construction, indicating a significant decrease of those parameters due to dam construction. In the case of

hydraulic radius, for example, the percentage of reduction of this parameter relative to the conditions before dam construction for the minimum, average and maximum characteristic discharges was reduced by 33%, 28% and 59% respectively [6].
In this research, the effect of Sarni dam and construction of Zarani dam on the organization plans of Mazabi River in Jomahleh dam has been discussed and it is investigated the flow conditions and hydraulic parameters of Mazab River in Jomahleh dam before and after the dam construction.

## MATERIALS AND METHODS

### TWO-DIMENSIONAL MODELING

The HEC-RAS 2D model has one-dimensional modeling capabilities in non-volatile conditions, as well as two-dimensional non-volatile conditions (using Saint-Venant or diffusion wave equations) as well as a one-dimensional and two-dimensional coupling model in volatile conditions. The finite volume algorithm is implicitly (or explicitly) used to solve the two-dimensional equations in unsteady flow conditions. The implicit solution method makes it possible to use larger time steps than the explicit solution method. The finite volume method also has more robustness and finite difference than other older finite element techniques. In this method, the function of two-dimensional and dry cells is much stronger than other methods. The two-dimensional flow range can start modeling from completely dry conditions and include sudden flow into the range. In addition, the computational algorithm can support different flow regimes including subcritical, supercritical, and complex (such as hydraulic jump). The software is designed to use an unstructured computing network, but it can also use a structured computing network. Following are the steps of preparing the geometry and bonding, determining the initial and boundary conditions, and simulating and viewing the results. [5].

## GOVERNING EQUATIONS

Neuer-Stokes equations interpret fluid motion in three dimensions. However, in the case of flood and hydraulic flow modeling in open channels, simplification of the governing equations is possible. One of these simplifications is the use of shallow-flow equations. Because the effect of vertical flows is relatively small compared to usually flows, two-dimensional in-depth averaged equations are generally used. Hydraulic studies of open channels are accepted with acceptable accuracy and efficiency. The momentum equation for two-dimensional deep-averaged turbulent currents in the Cartesian coordinate system is as follows:

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -g\frac{\partial H}{\partial x} + \vartheta_t\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) - c_f u + fv \qquad (1)$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} = -g\frac{\partial H}{\partial y} + \vartheta_t\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) - c_f v + fu \qquad (2)$$

Where u and v are respectively the velocity components in the x and y directions, time t, gravity acceleration, H water level elevation, ρ water density, H water depth, f Cryolysis parameter, Vt horizontal vortex viscosity coefficient And Cf is the friction coefficient of the foam. The free surface water level is calculated using the averaged continuity equation as follows:

$$\frac{\partial H}{\partial t} + \frac{\partial (hu)}{\partial x} + \frac{\partial (hv)}{\partial y} + q = 0 \qquad (3)$$

Where q is the well [5].

## STUDY AREA

study area includes the Joumahleh River catchment. The Jumeelah River catchment is a part of Bandar Abbas-Sedij catchment in Hormozgan province and has an approximate area of 2960.7 km2. Figure (1a) shows the hydrological location of the catchments in Iran. The two main tributaries of the Joumahleh River are the Mazabi and Karyan Rivers and will begin at the confluence of the two rivers under study. According to the conditions of the study area, it was divided into 36 main sub-basins. Figure (1b) shows the location of the Joumahla River basins and the location of the Sarni and Mazabi dams. The Serni dam will be constructed 6 kilometers east of Kahordaran village and 34 kilometers to the east of MinabShahr. The river bed width varies from 80 to 120 meters in the area of the site. The Sarni Reservoir Dam is a type of earth dam with a Natrava core. The height of the dam is 52 meters from level 94 in the river up to level 146 in the dam crest.

Figure 1-A- Hydrological position of the study area in Iran Figure 1-B- Location of Joomahleh River basins and location of Sarni and Zarani dams

## Data and procedure used

In this study, the HEC-HMS precipitation-runoff model was used to obtain floods at the outlet of sub-basins. The results of the model were compared using the results of floods at the gauge station at different return periods and the parameters of the model were rechecked according to the results of floods at the station. Three different scenarios have been defined to study the effect and extent of floods on the organization plans of the Mazabi River in the Jumeelah region.

A) Scenario 1: Modeling results are estimated using natural river conditions (without considering the effect of the dam on the main river and its tributaries) and at the outlet point of the Jumeelah catchment.

B) Scenario 2: The modeling results are estimated using the river basin setting conditions, taking into account the construction of the Serni dam on the main river and its tributaries) and at the exit point of the Jumeelah catchment.

Scenario 3: The modeling results are estimated using river adjustment conditions and taking into account the effect of the upstream dam and future dam construction at the exit point of the Jumeelah catchment

Canal Embankment Description

All papers will take evaluation process in the referee committee. For a paper to be considered for evaluation process, the author should submit his/her full length paper in docx and pdf formats with embedded fonts. Make sure that you revoke the “do not sent fonts to Adobe Acrobat” option while creating the pdf file. Please include all relevant materials (text and accompanying figures) into a single document.

The acceptance of received papers will be communicated with the corresponding author and can be tracked by all authors through the conference website. A paper which receives final or conditional acceptance should be prepared regarding the requested corrections, and the paper should be sent again via conference web site.

The results of the floods with different return periods in scenarios 1, 2 and 3 are presented in Table (1).

Table (1) Flood Results at the Exit Location of Jumahleh River Basin with Different Return Periods

| Return period | | | | | | | | Scenario title | Scenario number |
|---|---|---|---|---|---|---|---|---|---|
| 500 | 200 | 100 | 50 | 25 | 10 | 5 | 2 | | |
| 5101 | 4018 | 3300 | 2668 | 2089 | 1430 | 990 | 478 | natural conditions | 1 |
| 4693 | 3685 | 3009 | 2417 | 1878 | 1269 | 868 | 411 | Performance of the Cerrine Dam | 2 |
| 4229 | 3308 | 2697 | 2162 | 1676 | 1128 | 769 | 361 | Performance of the Sarni dam and construction of the Zarani dam | 3 |

In order to investigate the effects of the Sarni and Zarani dams on the Jumeelah River, the floods obtained from the above three scenarios are simulated in the two-dimensional HEC-RAS model. In the two-dimensional model, 1: 2000 scale topographic maps were used to produce the river geometry to provide a computational grid over the river bed (Figure 2). Also due to the high extent of the river floodplain and consequently the inadequacy of large scale topographic maps, to cover a wider range of 1: 25000 maps as well as the available altitude data (DEM) data from this area with precision 10 Meters are used.

River roughness coefficient in the study area was estimated by using field visits and engineering judgments and completing SCS method checklists, ranging from about 0.045 to 0.075 in different parts of the main channel and flood plain. In the two-dimensional model of the river Jumeelah the boundary conditions are introduced as a 25-year flood hydrograph at the inlet of flow and at the outlet as normal depth. In this project, a nominal accuracy of 30 * 30 m is calculated for the computational grid cells, and as a result 71904 cells are built into this two-dimensional model. 8]

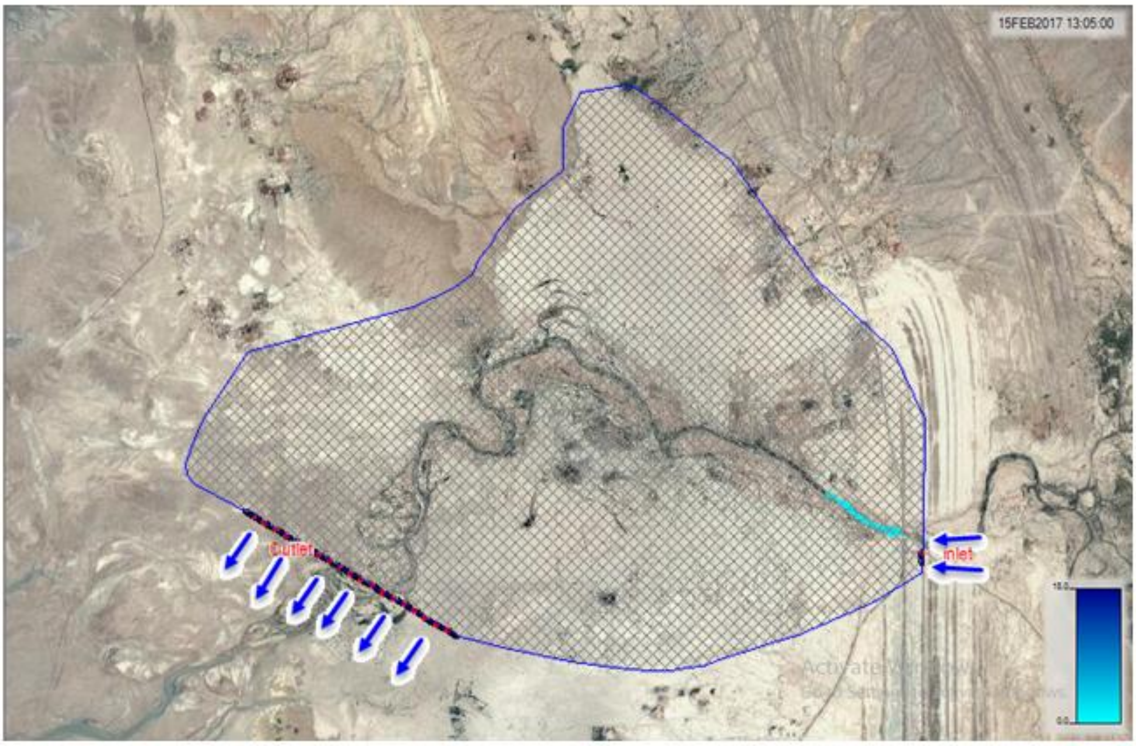


Figure 2 shows the computational grid position and boundary conditions introduced to the two-dimensional model

## RESULTS AND DISCUSSION

Figure 3 shows the floodplain of 25 rivers in two scenarios 1 (natural conditions) and scenario 3 (reservoirs of both dams). Studies show that considering the effects of both dams, the 25-year flood-prone area in the flood plain is reduced by about 38%. The reason for this dramatic decrease is the smooth topography of the floodplain on the margin of the Mazabi River in the Jumeelah area.

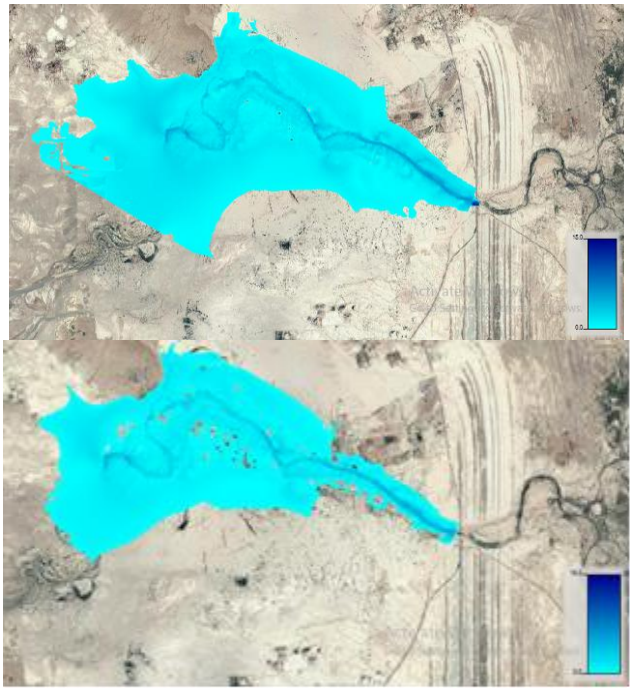

Figure 3a-floodplain 25 in scenario 3 (dams reservoirs) Figure 3b-floodplain 25 in scenario 1 (natural conditions)

Past flood records in this area confirm the wide floodplain in the Mazabi and Karyan basins located upstream of the study area. Figure 4 shows an image of the flood in 2010 in the mazabi branch in the Talang area upstream of the studied area and also the location of the photograph.

Also, in order to investigate the effect of the Serni and Zarani dams on the hydraulic parameters in the river main channel, 118 points were determined and then the hydraulic parameters of velocity and depth in these points were compared during the modeling of three scenarios. Figure 5 shows the position of the surveyed points on the river plan.

Figure 4-a- Flood storm 2010 at the top of the study period Figure 4-B- Likely location of the photo

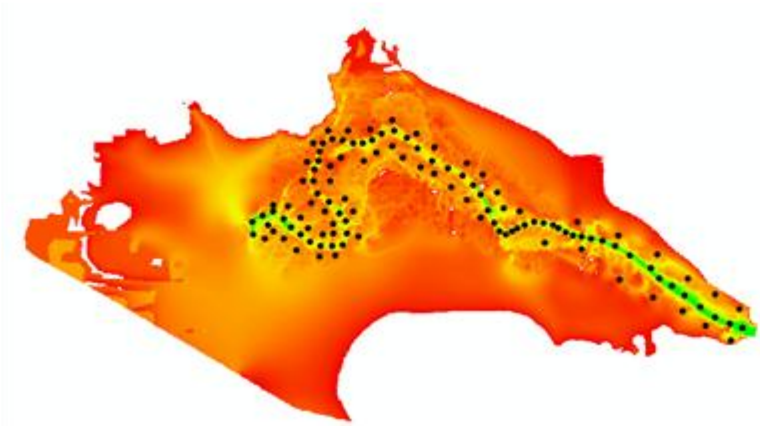

Figure (5) - Position of the investigated points
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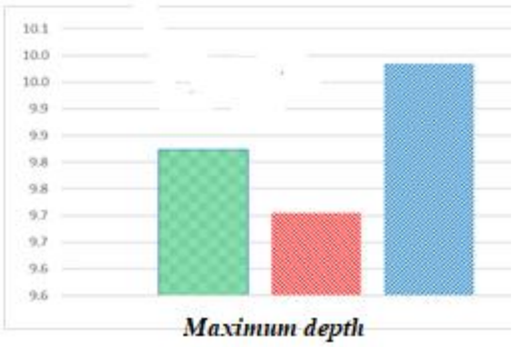

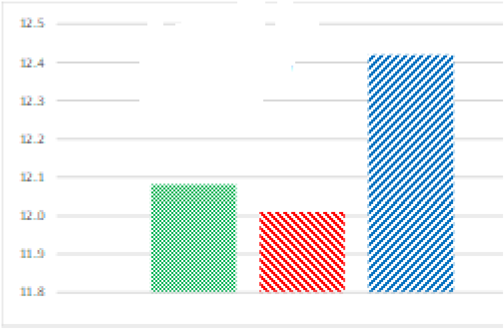


Figure (6-a) - Comparison of flow rate in three scenarios Figure (6-b) - Comparison of flow depth in three scenarios

Figure 6 - Comparison of depth and flow velocity values in different scenarios

As can be seen, the values show a decrease of about 2.8% of speed in Scenario 2 compared to Scenario 1 and a decrease of about 3.3% in Scenario 3 compared to Scenario 1. Also, depth in scenario 2 decreased by 1.7% in scenario 1 and in scenario 3 by 2.9%. However, despite very minor variations in the hydraulic parameters of the flow within the main channel area of the floodplain at the flank and flood plain.

The significant impact of the construction of the Zarani Dam and the Sarni Dam on flood reduction in the floodplain (38% reduction in floodplains) will be very effective in organizing the Jumeelah River and will reduce the size of structures designed to control floods. In some intervals, the depth and velocity of the flood will be reduced to such an extent that it is not necessary to carry out a reorganization plan in this area.

## CONCLUSION

Dams are among the most important human-made structures along the river that can cause major changes in the river and eventually in the entire catchment. Dam construction is one of the structural methods that plays an important role in flood control. The dams reduce the flood peak and reduce the risk of flooding in downstream areas by storing part of the flood currents in their flood control volume. The results of this study show:

1. The Sarni Dam caused a 10% decrease in the peak flood discharge with the return periods of 25, 50 and 100 years downstream of the study area. In the future, the construction of a dam in the future along with the Sarni dam will reduce these values by 20% downstream.

2- Considering the reservoir effect of both Sarni and Zarani dams, the 25-year flood affected area in the flood plain has been reduced by approximately 38% due to the smooth topography of the floodplain on the margin of the Mazabi River in the Jumeelah area.

3 - Despite significant changes in flow distribution in the floodplain, the change in hydraulic parameters in the main channel range is negligible.

4. The effects of flood control on these dams will result in lower costs of organization or elimination of most of these plans.

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