ARTICLE

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# The Economical Effect of Water Supply Systems Using Domestic Pumps or Elevated Tanks in Hilla City

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## Abstract

Infrastructure for the collection, transmission, treatment, storage, and distribution of water for residences, business enterprises, industry, and irrigation, as well as for public needs like firefighting and street flushing are all parts of the water supply system. The provision of drinkable water is possibly the most important of all municipal services. The expenses of employing an elevated tanks water delivery system in Hila City using a large number of home pumps were compared in this study for the period 2010-2020. According to a questionnaire distributed in different zones of the province, (88, 70) percent of residual units in Hila city used pumps in 2010, (25, 35) percent are workable after this period, and so on annually until 2020. The prices of importing domestic pumps were considerable in compared to the expenses of building elevated tanks, according to the findings. Both types of water systems have a purpose.

**Keywords**:- Water supply system, Water distribution, Domestic pumps, High pressure efficiency, Small amount of water, Hydraulic pipe network.

### 1.1 Introduction

Water resources are naturally occurring water resources that have the potential to be helpful. Agricultural, industrial, household, recreational, and environmental activities all use water. Water is required for all living things to develop and reproduce. Only 3% of the water on Earth is fresh water, with slightly more than two-thirds of it frozen in glaciers and polar ice caps. [1] The unfrozen freshwater that remains is mostly found as groundwater, with only a small fraction present above ground or in the air. [2] Although fresh water is a renewable resource, the world's supply of groundwater is progressively diminishing, with depletion primarily occurring in Asia, South America, and North America, however it is still unknown how much natural renewal balances this usage and whether ecosystems are impacted. Water can be delivered to homes, residential areas, and factories in a variety of ways. The delivery mechanism varies depending on the nature of the product. Fresh water is a renewable resource, yet the world's





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supply of groundwater is steadily decreasing, with depletion occurring most prominently in Asia, South America and North America, although it is still unclear how much natural renewal balances this usage, and whether ecosystems are threatened. There are many means to help deliver water to homes, residential areas and factories. The delivery mechanism differs according to the nature of the land, economic conditions, social customs, and the type of target area if it is residential or industrial areas. In this research, we will get acquainted with the economic impact and the calculation of the construction cost of domestic pump and elevated tanks in the Hila city. It can be deal with the economic aspects and calculate all the costs and economic feasibility of using these types, as well as the material benefits resulting from this basis in Hila city. Storage capacity of the water tank should meet peak flow requirements, equalize system pressures, and provide emergency water supply. The water supply system must provide flows of water sufficient quantity to meet all points of demand in the distribution system. To do so, pressure levels within the distribution system must be high enough to provide suitable pressure, and water distribution mains must be large enough to carry these flows.[3] In multiple pressure level systems, ground storage tanks are usually located at the interface between pressure zones with water from the lower pressure zones filling the tanks and being passed to higher pressure zones through adjacent pump stations.[4]**.** Introduced an experimental water distribution system (EWDSTUG) equipped with a smart water network comprising measurement and control devices, data collection and communication, data display and management as well as data fusion and analysis. According to them water supply system subject to continues change & development. Improving efficiency and reliability of the buried Infrastructure are expected benefits from the smart water system. [5]**.** Studied the water distribution network in Tirunelveli city is too old so the CI pipes are corroded, and AC mains are in incursion condition, so there is a leakage in the distribution system. The analysis was carried out by two methods that were LOOP developed by World Bank and Bently Water GEMS software. On the comparison of this two software, Water GEMS is more efficient to use in practice [6].

The aim of this study is to calculate the economic cost of constructing domestic pump and elevated tanks used to deliver water and its effects to the Hilla city and for the purpose of applying the feasibility study, taking into account the quality of the materials used in the construction.

### 1.2 Case Study

Hillah (sometimes written Hila) is a city in central Iraq located on the Euphrates River's Hila branch, 100 kilometers (62 miles) south of Baghdad. In 1998, the population was expected to be 364,700. It is the capital of Babylon Province and is situated near the ancient cities of Borsippa and Kish, as well as the ancient metropolis of Babylon. The city was previously a prominent center for Islamic education and knowledge. In the nearby settlement of Al Kifl, the grave of the Jewish prophet Ezekiel is said to be situated. The Hilla branch of the Euphrates began to silt up in the 19th century, resulting in the loss of much agricultural land due to drought. This was reversed by the construction of the Hindiya Barrage in 1911-1913, which diverted water from the deeper Hindiya branch of the Euphrates into the Hilla canal. [1] During an uprising in 1920, it experienced a lot of combat.

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**Figure (1) shown the population of Babylon governorate [3]**

## 1.3 Materials and Methods

### 1.3.1. Demographic Information

According to statistics from the city the population in 2015 was 970,000 people per capita of Hilla, according to information from the Department of Statistics, and since an average of seven people lived in each housing unit, the total number of residual units could be around 140,000 in 2015, and it could be more after this year as the difference is up to six years for the year 2021, which is the statistical information that will be worked with

### 1.3.2. Assumptions of calculations .

The calculations will contain the following assumptions according to a questionnaire distributed in different zones of the province:

1- Assume 88% of residual units in the Hilla city. used pumps and 12% do not use it.

2- Assume 70% of residual units in the Hilla city used pumps and 30 % do not us it.

## 1.4. Results and discussion

### 1.4.1. Determined the price of an elevated tank

Determined the price of an elevated tank that was used to decide the price of a 900,000-liter concrete tank. This diagram depicts its specifications. The above figure is the cost of building the elevated tank in Iraqi dinars. However, the costs of the pumps, maintenance, and operation will be included.. if the Iraqi dinar is calculated against the dollar at the current time, that is, "1 dollar = 1470 Iraqi dinars" at the time of writing the research.. and therefore the entire cost of the elevated tank will be as follows: In dollars, the tank costs $2,108,025,000/1470 =

1434030.6 $. Total cost of chosen tank = building cost + maintenance cost + operation cost (assuming maintenance and operation costs are 20% of construction costs), hence total cost = 1434030.6 $ + 2(286806.12) = 2007642.84 $ This price isn't set in stone because there are many types of tanks with different specifications and capacity... concrete or iron tanks, for example.

### 1.4.2. Use of domestic pumps

Before starting the calculation of the cost of the pumps, it must be noted that there are different brands of the pump industry like Chinese, German ,Italian and others with different prices, and it may lead the consumer to buy the pumps at low prices as a result of the low standard of living for the largest proportion of the segments of society. Two cases above could be used for year 2010 and next years each case will be studied the two probability of annual consumption of the pumps as following:

- After 2010, 25% of pumps are still operational, while 75% of pumps are inactive due to commercial reasons
- In 2010, 35% of pumps are still operational, whereas 60% of pumps are inactive due to commercial reasons As a result, the following computations may be made:-

**First Case:**

For 2010, a percentage of leftover units in Hila city used pumps, and after that, 25% are workable, and so on annually until 2020. Pumps used for residual units: 140000* 0.88=123200 Total Dollar Consumption: 123200*50$ =6160000 in dollars, 6160000*0.25=1540000 is a good working number. $ In dollars, multiply 6160000 by 1540000 to get 4620000. $ The dollar consumption forecast for the coming year2011: 6160000+4620000=10780000$

2012:10780000 +4620000=15400000$
2013: 15400000+4620000=20020000 $
2014: 20020000+4620000=24640000 $
2015: 24640000+4620000=29260000 $
2016: 29260000+4620000=33880000 $
2017: 33880000+4620000=38500000 $
2018:38500000+4620000=43120000 $
2019: 43120000+4620000=47740000 $
2020: 47740000+4620000=52360000 $

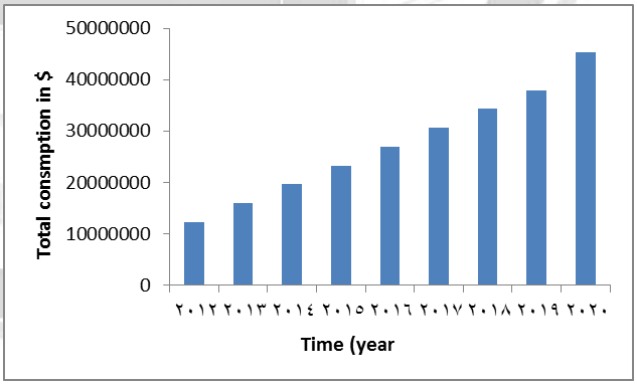


**Figure (2) for the first case.**

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**Second Case:**

Pumps until 2010, after which time, 35 percent are workable, and so on annually until 2020. Pumps used for residual units: 140000* 0.88=123200

Total Dollar Consumption: 123200*50$ =6160000 $ 6160000*0.35=2156000$

In dollars, multiply 6160000 by 2156000 to get 4004000

The dollar consumption forecast for the coming year2011:

2011: 6160000 +4004000=10164000 $

2012:10164000+4004000=14168000 $

2013: 14168000+4004000=18172000 $

2014: 18172000+4004000=22176000 $

2015: 22,176,000+4,004,000=26,180,300 $

2016: 26,180,000+4,004,000=30,184,000 $

2017: 30,184,000+4,004,000=34,188,000 $

2018: 34,188,000+4,004,000=38,192,000 $

2019: 38,192,000+4,004,000=42,196,000$

2020: 42,196,000+4,004,000=46,200,000 $

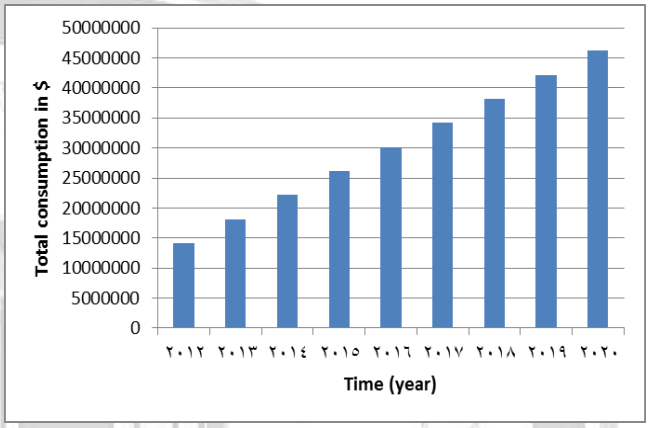


**Figure (3) for the second case**

**Third Case:**

% ٧٠In Hilla city, 70% of residual units used pumps until 2010, after which time, 25% are workable, and so on annually until 2020. Pumps used for residual units: 140,000 *0.7=98,000$

Total dollar consumption: 98,000 * $50 = 4,900,000$

Working in dollars is good: 4,900,000 * 0.25=1,225,000$

In dollars, multiply 4,900,000 by 1,225,000 to get 3,675,000$

The following are the dollar consumption forecasts for the coming years:

(2011): 4,900,000+3,675,000=8,575,000 $

(2012): 8,575,000+3,675,000=12,250,000 $

(2013):12,250,000+3,675,000=15,925,000 $

(2014):15,975,000+3,675,000=19,600,000 $

(2015):19,600,000+3,675,000=23,275,000 $

(2016): 23,275,000+3,675,000=26,950,000 $

(2017): 26,950,000+3,675,000=30,625,000 $

(2018):30,625,000+3,675,000=34,300,000 $

(2019): 34,300,000+3,675,000=37,975,000 $

(2020): 37,975,000+3,675,000=45,325,000 $

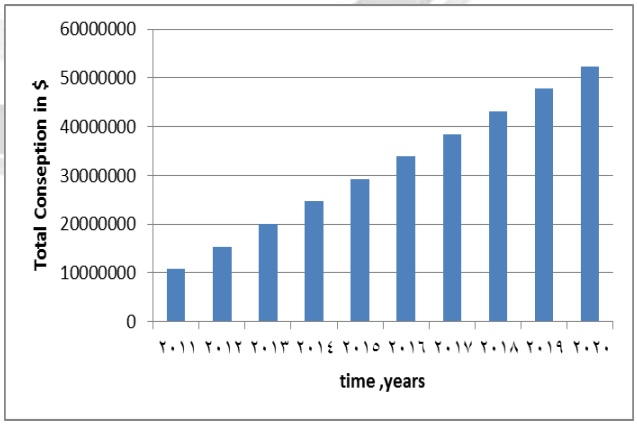


**Figure (4) for the third case**

**Fourth Case:**

% ٧٠For 2010, 70 percent of residual units in Hilla city used pumps, and after that, 35 percent are still operational, and so on annually until 2020. Pumps used for residual units: 140,000 *0.7=98,000

Total dollar consumption: 98,000 * $50 = $4,900,000$

Working in dollars is good: 4,900,000 * 0.35=1,715,000$

In dollars, add: 4,900,0001,715,000=3,185,000 -$

The following are the dollar consumption forecasts for the coming years:

(٢٠١١) :$ ٨,٠٨٥,٠٠٠=٣,١٨٥,٠٠٠+٤,٩٠٠,٠٠٠

(٢٠١٢) :$ ١١,٢٧٠,٠٠٠=٣,١٨٥,٠٠٠+٨,٠٨٥,٠٠٠

(٢٠١٣) :$ ١٤,٤٥٥,٠٠٠=٣,١٨٥,٠٠٠+١١,٢٧٠,٠٠٠

(٢٠١٤) :$ ١٧,٦٤٠,٠٠٠=٣,١٨٥,٠٠٠+١٤,٤٥٥,٠٠٠

(٢٠١٥) :$ ٢٠,٨٢٥,٠٠٠=٣,١٨٥,٠٠٠+١٧,٦٤٠,٠٠٠

(٢٠١٦) :$ ٢٤,٠١٠,٠٠٠=٣,١٨٥,٠٠٠+٢٠,٨٢٥,٠٠٠

(٢٠١٧): $ ٢٧,١٩٥,٠٠٠=٣,١٨٥,٠٠٠+٢٤,٠١٠,٠٠٠

(٢٠١٨) :$ ٣٠,٣٨٠,٠٠٠=٣,١٨٥,٠٠٠+٢٧,١٩٥,٠٠٠

(٢٠١٩) :$ ٣٣,٥٦٥,٠٠٠=٣,١٨٥,٠٠٠+٣٠,٣٨٠,٠٠٠

(٢٠٢٠) :$ ٣٦,٧٥٠,٠٠٠=٣,١٨٥,٠٠٠+٣٣,٥٦٥,٠٠٠

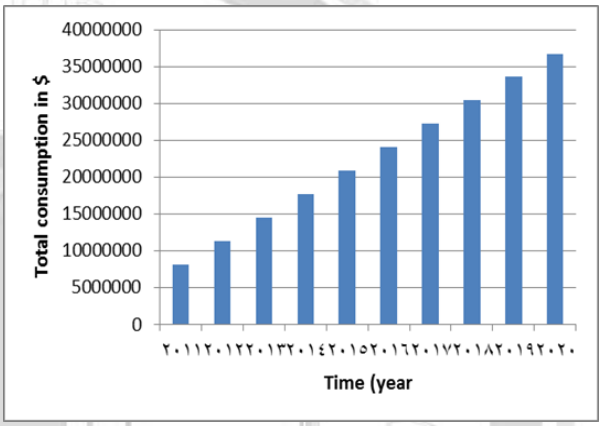


**Figure (٥) for the Fourth Case**

**Analysis and Comparisons:**

When a comparison was made between the cost of the elevated tank that was chosen, which is an approximate calculation even if the cost was more or less than the real cost, and the calculations of residual pumps, a large number of elevated tanks could be obtained, and the matter would have been in the service of the country. The situation necessitates careful and realistic planning. In each case, it can be explained how much tanks can be used instead of pumps table (1):

Number of tanks that can be built = 52360000 $ / 2007642.84 $= 26 tanks in the first case.

Number of tanks that can be built = 46,200,000 $/2007642= 23 tanks in the second case.

Number of tanks that can be built = 45,325,000 $ / 2007642.84 $= 23 tanks in the third case

Fourth case: Total number of tanks that can be built = 36,750,000 $ / 2007642.84 $

Tanks = 14

So, in the worst-case scenario, 14 tanks will be built until 2020, which is a significant number.

The drinking water crisis in Hilla city could be resolved.

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**Table (1) show the the result of fourth case:-**

| year | First case | Second case | Third case | Fourth case |
|---|---|---|---|---|
| 2011 | 10780000$ | 10164000 $ | 8,575,000 $ | $٨,٠٨٥,٠٠٠ |
| 2012 | 15400000$ | 14168000 $ | 12,250,000 $ | ١١,٢٧٠,٠٠٠ $ |
| 2013 | 20020000 $ | 18172000 $ | 15,925,000 $ | ١٤,٤٥٥,٠٠٠ $ |
| 2014 | 24640000 $ | 22176000 $ | 19,600,000 $ | ١٧,٦٤٠,٠٠٠ $ |
| 2015 | 29260000 $ | 26,180,300 $ | 23,275,000 $ | ٢٠,٨٢٥,٠٠٠ $ |
| 2016 | 33880000 $ | 30,184,000 $ | 26,950,000 $ | ٢٤,٠١٠,٠٠٠ $ |
| 2017 | 38500000 $ | 34,188,000 $ | 30,625,000 $ | ٢٧,١٩٥,٠٠٠ $ |
| 2018 | 43120000 $ | 38,192,000 $ | 34,300,000 $ | ٣٠,٣٨٠,٠٠٠ $ |
| 2019 | 47740000 $ | 42,196,000$ | 37,975,000 $ | $٣٣,٥٦٥,٠٠٠ |
| 2020 | 52360000 $ | 46,200,000 $ | 45,325,000 $ | ٣٦,٧٥٠,٠٠٠ $ |
| **Total number of tanks that can be built** | 26 | ٢٣ | 23 | ١٤ |

**Conclusions**

1-Importing large numbers of domestic pumps is a waste.

2-Water projects are not planned or based on research.

3-According to the calculations, there are significant differences that can be invested in tank construction.

**Reference**

[١] Inghug Delicia "Earth's water distribution ". United States Geological Survey. Retrieved (https://www.annalsofrscb.ro.) 2009 .

[2] Gleeson, Tom; Wada, Yoshihide; Bierkens,"Scientific Facts on Water: State of the Resource". Green Facts Website. Retrieved (https://punecityneha.wordpress.com/2015/07/28/water-resources).

[٣] AED Design Requirements: Water Tanks & System Distribution, US Army corps of engineers,SEPTEMBER 2009 Version 1.2. P (1).

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[4] Akbari, A. "Application of GIS and RS in water supply systems". The 28th Asian Conference. 2007.

[5] Anjana G, S. K. "A particle fliter based leak detection technique for water distrbution systems. Procedia Engineering .2015

[6] Allen, A. P. "On-line hydrauluic modeling of a water distribution system in singapore. Aerican scoienty of Civil Engineers .2014

[7] Money, Robert I. "The Hindiya Barrage, Mesopotamia". The Geographical Journal. 50 (3): 217-222, 1917, doi: 10.2307/1779909. JSTOR 1779909.

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# التأثير الاقتصادي لأنظمة إمداد المياه باستخدام المضخات المنزلية أو الخزانات المرتفعة في مدينة الحلة

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**الخلاصة**

يعتبر نظام إمداد المياه بما في ذلك البنية التحتية لجمع ونقل ومعالجة وتخزين وتوزيع المياه للمنازل والمنشآت التجارية والصناعة والري، وكذلك لاحتياجات العامة مثل مكافحة الحرائق وتنظيف الشوارع. من بين جميع الخدمات البلدية، ربما يكون توفير مياه الشرب هو الاكثر أهمية. يعتمد الناس على الماء للشرب والطبخ والغسيل وحمل النفايات والاحتياجات المنزلية الاخرى. في جميع الاحوال، يجب أن تفي المياه بمتطلبات الجودة والكمية. في هذه الدراسة تم مقارنة للفترة بين ٢٠٢٠-٢٠١٠ لتكاليف استخدام خزانات المياه المرتفعة في مدينة الحلة وتكاليف استخدام عدد كبير من المضخات المنزلية. تم اخذ اربع حالات بالاعتماد على استبانة موزعة في مناطق مختلفة من المحافظة، (٧٠، ٨٨)٪ من الوحدات السكنية في مدينة الحلة تستخدم مضخات منزلية لعام ٢٠١٠ ، وبعد هذا الوقت يتم اخذ نسبة(٢٥،٣٥)٪ صالحة للعمل وهكذا سنويا حتى عام ٢٠٢٠ توضح النتائج أن تكاليف استيراد المضخات المحلية كانت مرتفعة مقارنة بتكاليف إنشاء الخزانات المرتفعة. كلا النوعين من أنظمة المياه يخدم المستهلك، لكن الخزانات المرتفعة ستعمل بشكل أفضل فيما يتعلق بكفاءة الضغط العالي التي تخدم مدينة الحلة وتحل مشاكل نقص المياه والضغط المنخفض يمكن اعتباره أحد الحلول في مدينة الحلة حيث يحصل المستهلكون على كمية قليلة من المياه ذات الضغط المنخفض والتي تدفعهم إلى استخدام المضخات المنزلية لسحب المياه من شبكة الانابيب الهيدروليكية وتخزينها في منزله.

**الكلمات الدالة:** – نظام تزويد المياه، مضخات منزلية، كفاءة الضغط العالي، مشاكل نقص المياه، شبكة انابيب هيدروليكية.





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