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RESEARCH PAPER

Investigation of the impact of rubber dams on the development of water resources of urban areas in Gilan Province, Iran

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Highlights

- There were evidences that Gilan province has been experiencing low water issues in recent years.
- The effects of rubber dams on the development of water resources in Guilan province, has been examined.
- This research is mainly library and documentary using the available statistics in relevant organizations.
- Projects showed effective results in the development of water resources in the province.

Graphical Abstract

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Abstract

Gilan Province is one of the most water-rich provinces in Iran, so it cannot be assumed that the province has problems with water scarcity or very limited problems, but there are indications that Gilan Province has problems with water in recent years. This study investigates the impact of rubber dams on water resources development in Guilan Province. This study is mainly based on library and documentary materials and was conducted using statistics available in relevant organizations. Due to the necessity of comprehensive water management in the province, rubber dams are expected to be effective in the development of water resources in the province due to their characteristics and efficiency such as compatibility with the environment, simplicity of construction, short design and construction time. Reasonable safety and stability compared to rigid structures due to the simplicity and ease of operation, reduction of operation costs, economic savings and solving some problems of hydraulic structures, has caused this type of dams to be used mostly in small and large water projects.

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1. Introduction

The most important issue in water resources planning is to create a logical balance between these limited resources and increasing costs that the benefits and costs associated with water redistribution cannot be easily considered and observed. Paying attention to proper and economical management of water resources can provide the possibility of more and more useful use of water. If these strategies are recognized and implemented, water resources can be developed on a large scale with economic methods. One of these measures is the construction of dams, especially rubber dams, which are highly compatible with the current ecological, economic and social conditions of the country. Now, the optimal or maximum use of surface runoff on the coast of the Caspian Sea is of great importance. In general, most of the surface water resulting from rainfall on the plain flows into the sea through rivers without use. Due to the lack of water storage tanks in the middle of the plain and the control of excess water in the basin as well as the surface runoff of the plain, control of some of these waters for agricultural use in downstream lands is of great importance. Therefore, plans to build water storage tanks in sections of rivers with low slopes, seem necessary (Babel et al., 2005).

The very low slope of the coastal lands has caused the periodic and seasonal changes of the water level as well as the tides of the sea water to provide the risk of saline water entering these lands to some extent. With the studies performed, a system that can collect water in the narrow bed of rivers and strengthen the surface aquifer to prevent the entry of saline water and does not collect any sediment in it and case of floods does not cause flooding of residential areas. , Will be the construction of a rubber dam (Hofstede, 1984).

The role of rubber dams is to store river flows in times of water shortage and pump water from the reservoir in order to supply agricultural water to agricultural lands along rivers. By creating a suitable reservoir, water storage is done and when there is no need in non-crop seasons by draining the air and water of the chamber while increasing the river capacity, the deposited sediments are also drained (Anabtawi et al., 2013). Now, in Gilan province, despite the relatively better water situation in the region and the country, in recent years due to overpopulation, uncontrolled water withdrawals, droughts, incessant migration from rural areas to cities and... The bells have been rung to make the best use of the balance between available resources and the need for water and the inability of existing infrastructure (Fig. 1).

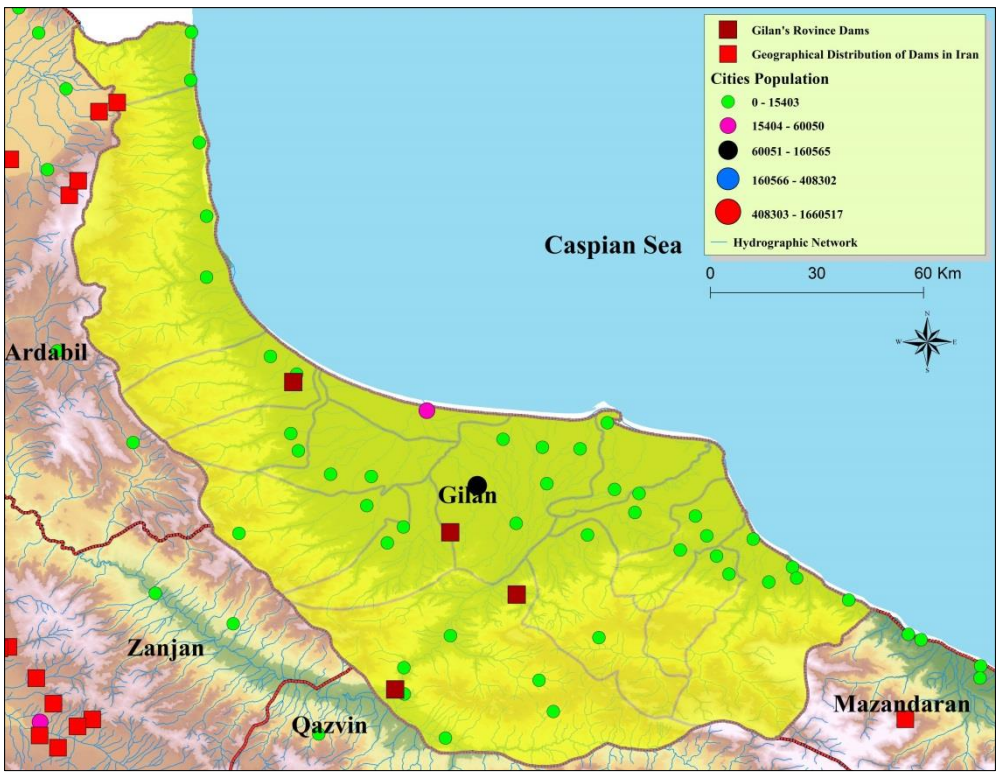

Fig. 1. Geographical distribution of dams in Gilan province.

Therefore, comprehensive water management in the province should be sought. Considering the mentioned contents and properties and efficiency of rubber dams as well as compatibility with the environment, simplicity of design, short design and construction time, their safety and proper stability compared to rigid structures, simplicity and ease of operation and finally reducing operating costs it is hoped that in order to save money and solve some problems of hydraulic structures, the use of this type of dams in small and large water projects will be done properly. If this situation is not controlled now, it will endanger all water-related jobs, the most important of which is agriculture, and will involve the province, the region and the country in this situation (McGrane, 2016).

2. Materials and methods

The method of this research is descriptive. The required information has been obtained using field information sources, books, documents, official databases of the country and information obtained from related organs and organizations.

2.1. Status of water resources and characteristics of the study area

Gilan province with an area of 14,820 square kilometers has about 9.0% of the total area, which is located in northern Iran in the Caspian Sea basin. Ideally, water allocation should be economically efficient, technically, practically, and socially just (Madani, 2014). Gilan province, while having 3.3 percent of the country's population, produces 10 percent of the country's food, which can be increased to 20 percent by providing the necessary arrangements. 3.3% of the country's population lives in Gilan province, but they have 7.3% of renewable water, which indicates the favorable condition of the province's water potential. The total water potential of Gilan province is about 18 billion cubic meters, of which 9456 million cubic meters are renewable and of this amount, 7493 million cubic meters are available. In the current situation, Gilan province with the only existing reservoir dam, the White River dam, in the best conditions is able to control, control and direct about 2 to 2.5 billion cubic meters of water required by different consumption sectors to the cycle of operation and consumption, while the total need the water of the province in the future and up to a 20-year perspective is approximately 5 billion cubic meters (Fig. 2). The rest of the province's water needs rely on groundwater resources, rivers and aquifers overlooking the White River network and inland rivers, which are not reliable in the current situation, so in recent years, Gilani farmers are facing water shortages in summer (Jia et al., 2018).

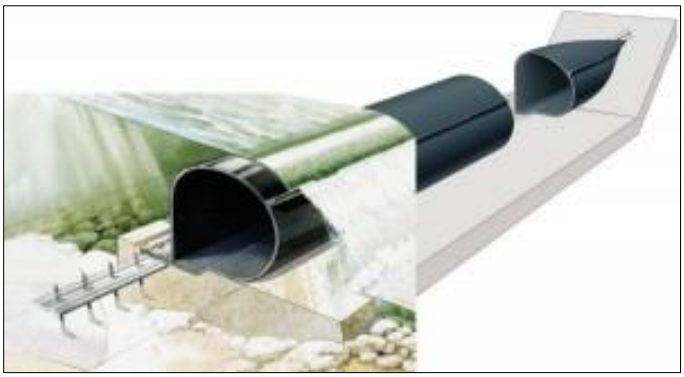

Fig. 2. The structure of Rubber Dams.

The efficiency of these dams is under the control of automatic and manual systems that are considered to support each other. One of the advantages of these dams is the ease of their installation and operation, in addition to the short duration of the project, its operation is also very easy, so that in addition to considering fully automatic systems to control its internal pressure, an efficient mechanical control system It is also very simple in its control system to prevent damage to the dam at critical times.

2.2. Gilan's province water potential

Inland basins of Gilan province, despite having very suitable rainfall and the number of rivers full of water (except for Sefidrood river, 54 main and secondary rivers and a number of small streams are flowing in Gilan province) face some basic problems and challenges. The most important of which are:

1) More than 75 to 80% of the province's rainfall occurs in non-crop seasons.

2) Inland rivers of the province generally do not have a suitable structure to store enough water. Therefore, more than 80% of agricultural lands, especially paddy lands in the province, relying on Sefidrood and consequently the relevant basin. Therefore, according to the mentioned cases and according to the calculations and measurements made from hydrometric stations located on some rivers of the province, from 15027 million cubic meters of water from rainfall in inland basins, about 4328 million cubic meters as Surface is stored in the rivers of the current province and about 473 million cubic meters are stored in underground aquifers. Both of the province's water potentials are renewable and accessible, and it is possible to plan for its control, containment, storage and harvesting with appropriate investments. In this regard, the total potential and renewable water of the province in surface and groundwater can be calculated as follows:

A) Surface water (25 years average up to 2012)

Incoming water from outside the province means bringing the Sefidrood basin to Gilan "Shahroud and Ghezel Ozan rivers" 2692 million cubic meters per year. In addition, 100 main and secondary rivers are flowing in the province. Water resources development projects in Gilan province have been among the strategies to try to relative assimilation of areas of water resources and the use of surplus water for emergencies. Renewable water of inland rivers of the province "54 main and secondary rivers except for Sefidrud" is 4328 million cubic meters per year.

B) Groundwater

Maximum possibility of exploiting the underground resources of "deep and semi-deep wells", which are generally located in the plains, 473 million cubic meters per year and the volume of water resources from the springs that make up the basin of the river, 2340 Million cubic meters per year, which is considered as the base discharge of rivers in the surface water sector due to flowing in the inland rivers of the province.

Therefore, the total potential of renewable and available water in Gilan province is equal to 7493 million cubic meters. According to the documents, expert studies and statistics, about 53% of the water potential of the renewable province and about 80% of the renewable water are available that can be invested in its development and operation (Bao et al.,2018).

3. Results and Discussion

3.1. Necessary policies and strategies for the optimal use of water resources

"In order to effectively deal with the challenges of managing the country's water resources, studies have been conducted in the country, the most obvious of which is the studies of the country's comprehensive water plan in 1374-78 and its revision. New both in the water sector and at the national level, the possibility of access to basic data with more accuracy and longer statistical period, in terms of climate change conditions and also the possibility of using new technologies (such as DSS, GIS, RS, mathematical models with capabilities Advanced, etc.) It is necessary to use the latest facilities and use the results of all available studies and reports, comprehensive water studies of the country to be updated to provide a suitable and up-to-date tool for comprehensive management of water resources at the level of grade 2 watersheds Give (Veról et al., 2020). The development documents of Gilan province mention policies to improve the situation of water resources in the province, most of which can be implemented in all cities of the province are as follows: Use of modern irrigation methods (pressurized systems) In orchards, reconstruction and completion and development of drainage irrigation networks, electricity supply to agricultural water wells, adequate water supply and conversion of rain-fed to irrigated crops by storing water flow, strengthening aquifers and observing the principles of

watershed management and promotion Sprinkler or drip irrigation, organizing, handing over, implementing and maintaining rural drinking water facilities to the non-governmental sector, implementing incentive policies to rehabilitate and rehabilitate dams, establishing small surface water control facilities, including headwaters, and Establishment of a diversion dam for storage, dredging of rivers and drains in the region to transfer and supply water and eliminate landslides, transfer and distribution and expansion of public belief in water as an economic commodity and its optimal use based on water consumption pattern mobile access to villages that do not have access to drinking water resources (Bao et al., 2020). Water facilities under operation in Gilan province are one of the most important solutions for the regional development of the province. In this regard, after civil engineering studies of Gilan plain and subsequent construction of White River reservoir dam, with the start of irrigation and drainage networks in downstream paddy lands and water intake of White River dam, based on studies conducted and the needs of Gilan plain and Fumanat, several facilities. Other infrastructure in the area was gradually constructed and put into operation. Rubber dams to prevent the return of seawater to the river and the interference of saline and fresh water, as well as creating a delay reservoir for water collection, collecting some of the water from rainfall, drainage of agricultural land in the growing season and to Agricultural consumption as well as recreational and tourist projects, aquaculture, preventing the interaction of salt water and fresh water, groundwater nutrition, is beneficial. Therefore, they can be one of the effective solutions in the field of water resources planning, which is explained below.

3.2. Reasons to pay attention to the rubber dam on the Caspian coast

Optimal or maximum use of surface runoff on the Caspian Sea coast is of great importance. In general, most of the surface water from rainfall flows into the sea through rivers without use. Due to the lack of water storage tanks in the middle of the plain and control of excess water in the basin as well as surface runoff of the plain, control of some of these waters for agricultural use in downstream lands is of great importance. Therefore, plans to build water storage tanks in sections of rivers with low slopes, seem necessary. The very low slope of the coastal lands has caused the periodic and seasonal changes of the water level as well as the tides of the sea water to provide the risk of saline water entering these lands to some extent. With the studies performed, a system that can collect water in the narrow bed of rivers and strengthen the surface aquifer to prevent the entry of saline water and does not collect any sediment in it and case of floods does not cause flooding of residential areas., Will be the construction of a rubber dam.

In fact, water resources development programs include the use of saline surface water and their desalination, extraction of groundwater by drilling wells and ... The most important, best and cheapest of them is the control of surface water by constructing diversion dams, especially rubber dams; Because the construction of small dams with rubber diversion reservoirs in the country, due to their adaptation to the climatic and economic conditions of the country, should be prioritized compared to other projects that have a long construction period and completion and will be fully operational after a few years. Because in many parts of Iran, the available surface water may not be sufficient for irrigation in some months of the year (summer and spring). Or the construction of such dams, we can control and store excess water in winter for critical seasons. The role of rubber dams is to store river flows in times of water shortage and pump water from the reservoir in order to supply agricultural water to agricultural lands along rivers. In the growing seasons, the rubber dam chamber (dam body) is filled with air or water and water is stored by creating a suitable reservoir. Is also evacuated (Wang et al., 2020).

3.3. The rubber dam is a solution for the economic development of water resources

Scholars believe that the water crisis should be seen not in relation to water scarcity but in poor water management. Agriculture, with 85% of global water consumption as the largest consumer of this resource, plays an important role in balancing the amount of water between competing uses (Zhang et al., 2002). Therefore, extracting the irrigation water demand function and determining the economic value and productivity of this scarce input is the first step in designing an optimal operation strategy. Areas of maintenance of these dams

include conducting monthly inspections by specialized, experienced and experienced persons who investigate possible problems. In general, it can be said that in countries that are careful in their operation and qualified people are used to maintain and repair rubber dams, the life of such dams is very long and in countries that do not take much care in operation. Usually the life of these dams will be short (Bao et al., 2018).

It should be noted that the operation and use of these dams are very simple and is done by training one person, but if a trained person does not accept this, factors such as the wrong amount of proper pressure of the dam, the height of its resistance to currents and Excessive and unauthorized increase of water height upstream can lead to damage to the dam tire. In some cases, the firing of bullets or the lack of culture for the general public can cause damage and problems for these dams. Therefore, in the operation of these dams, it is better to entrust this operation to a competent company or organization to avoid possible problems as much as possible. On the other hand, due to the sensitivity of using these dams for farmers in water shortage seasons, they should be maintained in such a way that at this time there is not the slightest problem in its operation and does not cause farmers to protest (Bao et al., 2018).

Because rigid structures such as concrete and earthen dams and… due to lack of deformation - form in front of the river flow and cause flooding of agricultural lands and lands, soil erosion and damage to residents and sometimes damage to the dam. It is better to use the replacement plan with rubber dams in areas that are at risk of possible and unusual floods or can be exposed to seasonal and sudden flood currents. Due to the mechanism of operation of these dams during floods and increasing pressure and as a result, the equilibrium pressure inside the tube is disturbed, this type of dam is deformed and placed on a concrete bed completely lying down and allowing the flow to pass without any obstacles.

These types of dams can be a barrier to the passage of flow and in the upstream area to provide the amount of water needed for various uses, including:

1) Supplying water needed by farmers and reducing pumping costs
2) Supplying the water needed to increase the water intake of boats and ships
3) Use for artificial feeding projects or watershed management uses

In order to prevent wastage of water and erosion of rivers in the flow path, the flow of rivers can be saved by using these dams.

1) The role of a rubber dam in preventing the interference of salt and fresh water in rivers leading to the sea
2) Use of rubber dams as diversion dams in agricultural water supply
3) Use of short rubber bands in fish and shrimp ponds
4) Used to beautify the face of cities and create tourist attractions

Due to the possibility of producing the main body of these dams and their hydromechanical system in the factory, fewer materials are needed, which makes it possible to build these dams in different areas. Also, in these dams, there is no limit in terms of length in the canopy and it is possible to produce and install up to 150 meters in one estuary, and in more lengths, it is possible to use several estuaries to widen the width of rivers. The applicable height of these dams is from 8.6 to 6 meters, which can be used to increase the level of concrete bed for higher heights., Short design and construction time, their safety and stability compared to rigid structures, simplicity and ease of operation and ultimately reduce operating costs, the hope is to use these dams to save money and solve some problems of hydraulic structures. To be done properly in small and large water projects of the country (Anabtawi et al., 2013).

After designing and constructing a rubber dam, it will be time to operate and maintain it, which will be one of the effective factors during the life of a dam. Successful and unsuccessful experiences of using rubber dams show that unsuitable operation method reduces the economic life of the project. In this regard, it can be suggested that the areas of maintenance of these dams, including conducting monthly inspections by experts, experienced and experienced people will prevent possible problems. In general, it can be said that in countries that are careful in their operation and qualified people are used to maintain and repair rubber dams, the life of

such dams is very long and in countries that do not pay much attention to the operation. Usually, the life of these dams will be short.

It should be noted that the operation and use of these dams is very simple and is done by training one person, but if a trained person does not accept this work, factors such as the wrong amount of proper pressure of the dam, the height of its resistance to currents Excessive and unauthorized increase of water height upstream can lead to dam rubber damage. In some cases, the firing of bullets or the lack of culture for the general public can cause damage and problems for these dams. Therefore, in the field of operation of these dams, it is better to entrust this operation to a competent company or organization in order to avoid possible problems as much as possible. On the other hand, due to the sensitivity of using these dams for farmers in the water shortage seasons, they should be maintained in such a way that at this time there is not the slightest problem in its operation and does not cause farmers to protest.

Due to the advantages such as no need for a complex foundation, the ability to run up to a span of 100 meters, the minimum need for protection and maintenance, the flexibility of the dam against earthquakes, installation and construction very fast; Use of rubber in hydro projects such as creating dams, dams, increasing the height and creating storage volume in dams, high economic efficiency, using rubber dams instead of valves, for trapping sediment, diversion dams and use in hydropower plants Compared to other dams, it has a higher priority, so if there are suitable environmental conditions and in accordance with the construction of this structure, rubber dams should be used.

4. Conclusion

Iran, as one of the countries in the dry belt of the earth, is facing the problem of water shortage. The increasing population growth and the need for agricultural and livestock products and the limitation of water and soil resources as the main basis of agricultural production have posed a very serious problem of water shortage in the country. The water crisis and the limitation of water resources should be considered as a serious problem for many countries now and in the near future for all countries of the world, because this limitation of the growth and excellence of countries can be overshadowed.

Therefore, comprehensive water management in the country and the province should be sought. Considering the mentioned contents and properties and efficiency of rubber dams as well as compatibility with the environment, simplicity of design, short design and construction time, their safety and proper stability compared to rigid structures, simplicity and ease of operation and finally reducing executive costs. In order to save money economically and solve some problems of hydraulic structures, the use of this type of dam in small and large water projects should be done properly.

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