

# Investigation of Dam Construction Effects without Environmental Assessment (Case Study: Urmia Lake)

Mehdi Majediasl<sup>1\*</sup>, Askar Sangi<sup>2</sup>

<sup>1</sup>Department of civil engineering, University of Maragheh, Maragheh, Iran

<sup>2</sup>Department of Geography, Ardabil Branch, Islamic Azad University, Ardabil, Iran

\*Corresponding author's Email address: mehdi.majedi@gmail.com

**ABSTRACT:** Feedbacks on numerous harmful problems in the environment have caused appearance of some human society's sensitivity about the range of human's non-limited activities in the environment which are done without considering environmental limitations during the economic development process in the recent decades. If environmental problems, along with technical and economic justifications are not considered, activities related to the water resources development program will result in irreparable and undesirable consequences. Drying up of the lake due to irregular exploitation of catchment basin water resources and construction of several dams on the branches of its rivers without environmental assessments have led to increase in the region's temperature, appearance of sand and salt storms, destruction of potential agricultural land, flooding, change in cultivation pattern, hence jeopardizing the life of region's people. Because of these, Natural ecosystems existing around the lake have been changed remarkably, and animals' habitat in the lake is going to be destroyed. So, it is necessary to carry out an accurate evaluation before implementing water resources projects during the investigation of economic and technical justifications, so that any exploitation of nature can be done in the framework of the capabilities and potentials of natural environment. In this paper, we present some approaches to fight against undesirable consequences of dam construction, investigating environmental changes in Urmia Lake.

**Keywords:** Water Resources Development, Dam, Environment, Urmia Lake

ORIGINAL ARTICLE

## INTRODUCTION

Having no substitute and being as a necessary element for life, water is a special natural endowment. Taking a quick look at the conditions of the water resources available to human and the other living organisms, one can notice that it is of much importance to consider water seriously and warily. Appearance of numerous problems over the last decades has caused human society to find that its activities have a non-limited range in the environment (Mitchell, 1996; Kates, Parris, and Leiserowitz, 2005). Environment, on the other hand, has some limitations which are not extendable even with use of the best imaginable technologies. Lack of respect to these limitations during the economic development process will result in destruction of the environment (Habitat, 1992). This is why any exploitation of the nature should be done within the framework of capabilities and capacities of the environment after evaluating the resources. Following the dissonance in country's growth, and creation of numerous problems such as poverty, unemployment, class gap, destruction of the earth's natural environments, several environmental pollutions, etc, and because of paying attention only to economic development, and ignoring the other aspects of the problem such as social-cultural and environmental aspects, a more comprehensive phrase, Sustainable Development, was introduced in the last decades of twentieth century. As a matter of fact, this phrase is a main element of "21 strategy"; a forty-chapter document which was accepted by the countries members of the United Nation in the Summit of the world's country

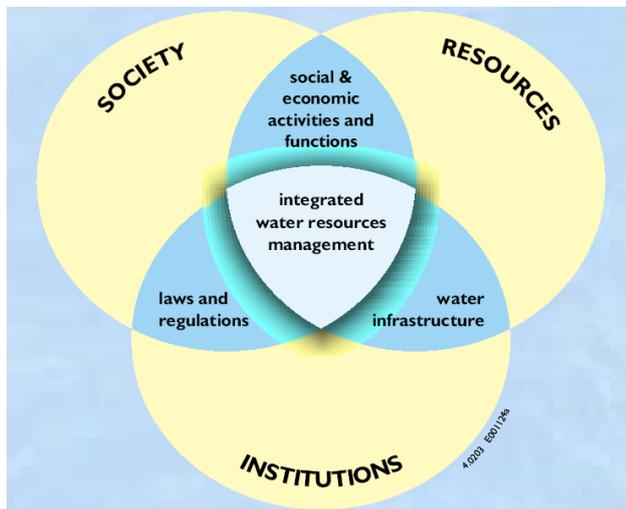
leaders in Rio de Janeiro (Molden et al., 2007).

Regarding sustainable development; "Sustainable Development is a development in which continuously provision of people's basic needs and satisfaction are obtained, along with increase in quality of life," said Alain Rober. About defining Sustainable Development; "Sustainable Development is a set of suggestions which can be presented in Ecology courses, and should be taken into consideration more," said J-Kumer. And finally; "Sustainable Development is a development in which needs of the current generation are obtained without decreasing future generation's abilities in provision of their needs (Goldsmith, Hildyard, 1992; Lire, 2005)," said kumision Brantland. From practical geography point of view, studies and planning of sustainable development is carried out relying on Systems Theory and emphasizing systemic attitude. In systemic attitude, human decides considering real images inspired by the environment, identification of the environment potential, and evaluation of how to reproduce the environment resources, and finally behave in a way which impose the minimum of negative effect on the existing balance (Hassanzadeh, Zarghami, Hassanzadeh, 2011).

Sustainable development can be practically realized only in the interface between triple components of social, economy, and ecology. Because of the human's increasing need for more food and also water in the future, and also because of his interference in the environment which increasingly menaces these needs, the sustainable issue in natural resources such as water and soil resources has become much important. Soil and water

are among the most important and the most available natural resources in ecologic processes. So, now it seems that sustainable development is not meaningful without taking soil and water resources conditions into consideration. In integrated management of water resources, establishing a highly variable relationship is necessary for optimizing water consumption and balanced distribution of water across the several consumption branches (Plate and Duckstain, 1988).

Figure 1 shows a schematic design of an integrated management of water resources (Delf, 1988).



**Figure 1.** The structure of water management

Dams and dam construction are of much importance. People in several regions have built dams over thousands years in order to control waters and to provide drinking and irrigation water, and also water required by industries. Simultaneous with the growth of population and economic activities during 1950s, dams were considered to be an appropriate tool for responding water needs and energy provision. Thenceforth, at least, 45,000 dams have been built in several countries. One of the most important things during construction of dams and the time after it is paying attention to environmental, economic, social, and cultural aspects of dams so that so many of researches have concluded that it is better not to build a dam because in some cases, construction of dams results in destruction of existing natural ecosystems and land usage patterns, and also vulnerability of the other natural resources negatively affecting them in a wide range. In other words, any planning to use water resources should be filtered through environmental investigation and precise recognition of the ecosystem governing the region, and any designs and projects should be done based on adaptation to this mechanism. Any developments with any degree of quantity or quality result in specific environmental effects. Human's interference in natural environment means making changes in the natural and initial form of the environment. Continuity of human's activity in changing natural conditions may finally lead to disrupt the balance governing the environment, and to make a chain of undesired or unexpected consequences as now human societies have become faced with them (Mellor, 1995). Global bank's division for strategy making in field of water resources is desirous of investment in "dangerous" fundamental projects section

such as dams in a manner compatible with the environment. This organization is also desirous of presenting an established plan to be used in development section of dangerous fundamental projects so that it can be able to predict environmental and social consequences in upstream and downstream structures at the considered time (Minten and Barrett, 2005).

All planning and policies applied to water section are carried out in order to provide human's life conditions. Since there is a direct relationship between protections of the environmental conditions and human survival, so it is unavoidable to apply the planning to the constructions related to water projects in order to protect aquatic and terrestrial ecosystems. For this purpose, it is necessary to carefully evaluate the effects of hydraulic structures on their upstream and downstream environment in order to minimize their negative effects. Evaluation of the environmental flows is the first step in this process. Environmental flows are those flows needed to protect aquatic ecosystems. In other words, river flow regime's ability to protect a complicated set of aquatic habitats and ecosystem processes is another definition of environmental flow. Environmental flow is designed and determined in order to protect or promote a river from an inappropriate condition to a desirable one. In addition, it can be said that river flows should provide the followings (Khan and Hanjra, 2008):

- Protection of river flow conditions such as speed, depth, darkness in such a degree that the river would be able to do self-refinement
- Keeping the minimum of flow in order to keep people's livelihoods (those people who use the water of river or lagoon or downstream lakes for drinking, hygiene, fishing, tourism, irrigation, etc.
- Sustainable development of aquatic and terrestrial ecosystems
- Feeding underground aquifers during severe floods
- Protection of deltaic conditions; the minimum flows keep the balance between saltwater and freshwater, and prevent saltwater from advancing.

Volume of water resources in each country depends on its climate, geographic, and geologic conditions, and can be consumed for unlimited times from a theoretic point of view. But as time goes by, human's ability to exploit water resources improves, and, as a result, water is consumed in a more efficient manner. For instance, although the volume of water resources has been remained constant, more facilities have been provided in exploitation of the existing water resources through using new methods such as drilling deep wells, exploitation of the resources existing in the earth's deep regions, or construction of large and small reservoir dams (Lire, 2005).

One of the most important things regarding dams Environmental, economic, social, and cultural aspects of dams are among the most important factors during construction of dams and the time after it because, in some cases, construction of a dam results in destruction of existing natural ecosystems and lands usage patterns, and also vulnerability of the other natural resources negatively affecting them in a wide range. Among the feedbacks on the negative effects of construction of dams due to lack of

paying attention to environmental aspects are threatening life in rivers, disruption of rivers' ecosystem balance, seismic activities, and outbreak of diseases. Also artificial lakes established because of construction of a dam have some negative environmental effects such as demotivating emigrant fishes to emigrate to the upstream side, and interference with fishing in downstream, interference with traditional agricultural operation made based on changes in the seasons, changes in river's behaviour, and untimely floods. In the following, undesirable effects of construction of several dams without evaluation of environmental indexes in Urmia Lake are discussed. At this time, this lack of attention is characterized as drying up of more than half area of the lake, and disruption of balance in the region's natural ecosystem.

## MATERIALS AND METHODS

### Case study (Position and geographic coordination)

Urmia Lake basin, which is located in the North-West of Iran, Figure 2, has a surface area of 51,866 km<sup>2</sup>. 35,147 km<sup>2</sup> of this area (equal to 67.8 percent) includes mountains, and 16,719 km<sup>2</sup> of it (equal to 32.2 percent) includes desert. This zone can be divided to three sub-fields; Eastern, Southern, and Western. According to the reports issued by the water resources investigation office, the water entering the lake is provided by 15 permanent rivers, 7 seasonal rivers often flowing in winter and spring, and around 39 watercourses. Dams existing around Urmia Lake field have following conditions (Figure 3) (Hassanzadeh, Zarghami, Hassanzadeh, 2011):

- Number of existing dams: 36
- Number of dams being built: 12
- Number of dams planned to be built: 40



**Figure 2.** The position of Urmia lake

Normal and deviated dams have been built on 14 out of 15 permanent rivers providing water of Urmia Lake. According to the report issued by the water resources investigation office, water resource of three rivers including Siminehroud, Ajichay, and Zarinehroud provide 60 percent of the total flow entered the Urmia Lake. In other words, the Lake is deprived of around 60 percent of its share because the entering flows of the three noted rivers have been blocked. Remained 40 percent is stored by the other dams, and is consumed for agriculture development. Figure 4 shows the trend of changes in surface decreasing trend of the Lake from 1963 to 2011. Researches indicate that construction of several dams, drilling authorized and unauthorized deep wells, climate changes, and very low efficiency of irrigation systems are among the factors causing such an environmental disaster

in the Lake. Researches and studies shows that 65 percent of the reasons for decrease in water level of the Lake is due to overuse of flowing waters, 25 percent is due to construction of dams and climate changes, and 10 percent is due to decrease in rainfall. As shown, 90 percent of the factors effective in decrease in water level are due to lack of paying attention to establishing the environmental flow in the dam downstream and in the Lake (Figure 4). Also Figure 5 shows the dramatic changes apparent in Urmia lake in comparison with Van and Sevan lakes. Results of the researches indicate that the amount of freshwater required by the Lake in order to meet the water balance is equal to 3.5 cubic milliard per year. This amount has decreased to around 500 million cubic meter due to lack of paying attention to the Lake's share through construction of dams and channels. Based on the available information, climate type is almost constant in a wide area of the watershed region of the Lake field, which has a height of less than 2000 meters. This shows that Urmia Lake has a climate-adjusting role in this climate region. Drying up of the Lake causes increase in the region's temperature, and, consequently, more increase in temperature; a process, which is considered a positive feedback. As others, the process will result only in destruction of the region. These changes will result in decrease in desorbed thermal energy and lack of a climate balance.

## RESULTS AND DISCUSSION

Based on the noted information, lack of paying attention to provision of the environmental flows in downstream to the dams built in the Lake field is the source of the main reasons for destruction of Urmia Lake. So, it is necessary to do some researches and actions to minimize the negative effects in the downstream environmental flow before construction of a dam. These actions may be categorized into two main groups: (a) Direct (b) Indirect. Tables 1 and 2 present direct and indirect actions in order to decrease undesirable effects of dams, respectively. Consequents of construction of dams without paying attention to environmental criteria will result in many desirable effects on the environment. Feedbacks on these consequences are characterized will be observable in forms of regional effects, water quality and quantity, organisms' habitat, and the environment. In order to minimize undesirable effects of construction of dams, it is necessary to consider criteria for protecting the existing natural conditions in both upstream and downstream during design stage. In this way, one can properly apply water resource management policies while paying attention to nature's rights. Lack of paying attention to natural water right upstream to Urmia Lake and unfair removal and storage of water in the lands upstream to the Lake are the most important factors causing gradually drying up of the lake. It is necessary to carry out integrated environmental studies as well as doing comprehensive economic, social, and technical assessment before constructing a dam in each field. Introducing negative effects of construction of dams without respecting environmental standards, we have presented strategies against those negative effects in two groups including direct and indirect strategies in this paper.



Figure 3. The number of dams within the Urmia lake's basin

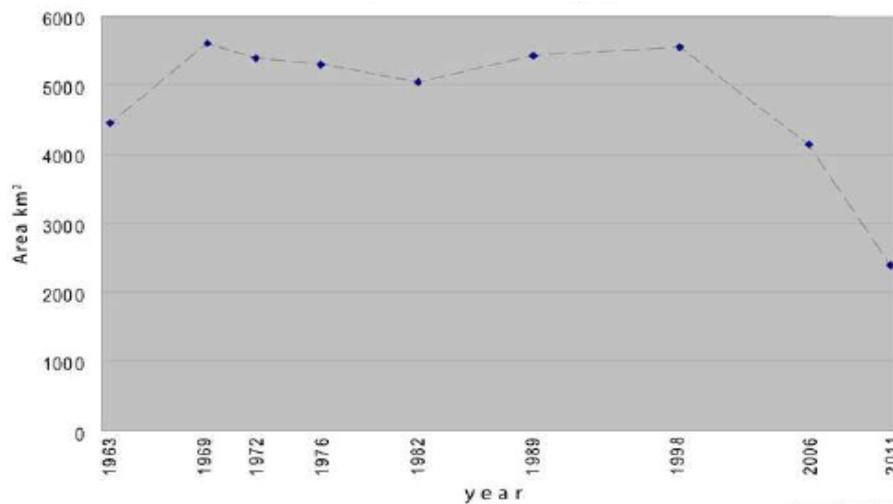


Figure 4. Urmia lake surface trend

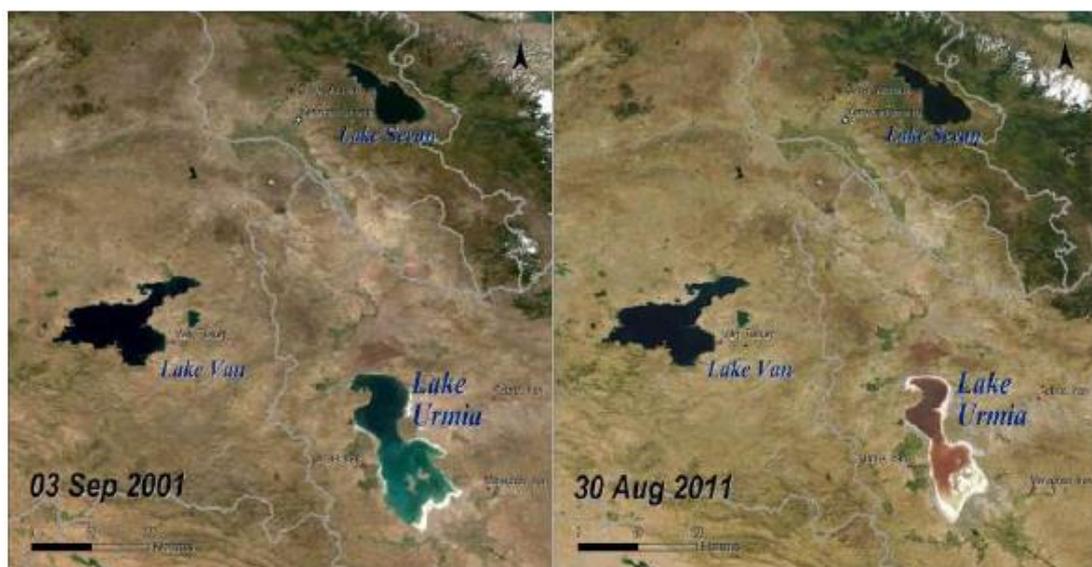


Figure 5. Comparison of three lakes of similar size- Lake Sevan, Lake Van and Urmia Lake from 2001 to 2011

**Table 1.** Direct actions to decrease negative effects of construction of a dam

Negative Effects	Necessary Actions
Drying up of downstream lagoons and natural lakes	Respecting to downstream natural water right in order to provide the environmental flow (the least)
Soil erosion	Appropriately locating camps, waterways, waste disposal places
Destruction of plant cover and hygiene problems due to camps	Reviving lands and Preventing them from erosion
Inappropriately locating local people in the adjacent region	Locating local people in appropriate regions, creating limitations for decreasing and consuming resources, presenting appropriate hygiene services, foundations, and making job opportunities
Losing agricultural, forest-pasture, and lagoon lands for creating lake and store place of dam	Positioning location of Dam where appropriate for preventing from reservoir losses, decreasing dam and reservoir size, planned protection of regions to decrease losses
Losing cultural-historic or aesthetics regions and buildings	
Destruction of and decrease in values of wildlife habitats and pristine areas	Positioning dam where appropriate, and/or decreasing dam size to prevent from our decreasing occurrence of losses-Building parks, or natural protected storage places-Saving animals through transferring them to compatible places
Increasing aquatic plants in store places or in downstream lands, irrigation systems, shipping and fishing, evaporation of water	Pruning wooden types plants in waterlogged regions related to floods through removing nutrients-Control of aquatic plants, Harvesting herbaceous plants with purpose of production of watery manure or biogas, Adjusting output water and regulating water level to prevent plants from growing
Destruction of water quality in store places and lake	Pruning wooden types plants in waterlogged and floods regions, and Control and management of lands usage, wastes disposal, and agricultural uses in watershed fields, Limiting retention time of water in store places
Increasing moisture and local creation of fog, appearance of appropriate habitat for insects which are vectors of diseases like Malaria	Control of insects through using reasonable struggle such as biological struggle

**Table 2.** Indirect actions in order to decrease negative effects of construction of dams

Negative Effects	Necessary Actions
Uncontrolled immigration of people to a region due to construction of access roads and power transfer lines	Limiting access roads, providing rural development and hygiene services to minimize effects
Environmental problems due to development which are created due to construction of dams such as agricultural lands under irrigation, industrial and municipal development	Integrated and extensive regional planning in filed area to prevent irregular use of soil and water resources
Non-significant usages of lands in field areas upstream to dam store places due to changes in water quality	On-land planning and preparation in lands upstream to dam to obtain efficient results

**REFERENCES**

- Delf Hydraulics (1988). Ecological modelling for reservoirs in the amazon area. Technical report.
- Goldsmith, E., Hildyard, N. (1992). The Social and Environmental Effects of Large Dams. Wadebridge Ecological Centre, Bodmin, UK.
- Habitat, T.A. (1992). A Methodological Framework of EIA for Urban development. UN Centre for Human Settlements, 11-18.
- Hassanzadeh, E., Zarghami, M., Hassanzadeh, Y.(2011). Determining the Main Factors in Declining the Urmia Lake Level by Using System Dynamics Modeling. *Water Resources Management*, 26(1): 129-145.
- Kates, R. W., Parris, T.M. and Leiserowitz, A. A. (2005). What is sustainable development? Goals, indicators, values, and practice. *Environment*, 47:10-21.
- Khan, S., Hanjra, M.A.(2008). Sustainable land and water management policies and practices: a pathway to environmental sustainability in large irrigation

- systems. *Land Degradation and Development*, 19, 469–487.
- Lire, E.(2005). Small-scale irrigation dams, agricultural production, and health: theory and evidence from Ethiopia. Policy Research Working, World Bank, Washington,DC.
- Lire, E.(2005). Small-scale irrigation dams, agricultural production, and health:theory and evidence from Ethiopia, Washington DC.
- Mellor, J.W.(1995). Agriculture on the Road to Industrialization. Hopkins university Press, Washington, DC.
- Minten, B., Barrett, C.B.(2005). Agricultural technology, productivity, poverty and food security in Madagascar. SAGA Working Paper. Cornell University, USA,
- Mitchell, G. (1996). Problems and fundamentals of sustainable development indicators. *Sustainable Development*,4:1-11.
- Molden, D., Frenken, K., Barker, R., De Fraiture, C., Mati, B., Svendsen, M., Sadoff, C., Finlayson, C.M. (2007). Trends in water and agricultural development. International Water Management Institute, London/Colombo.
- Plate, E.J., Duckstain, L (1988). Reliability-based design concepts in hydraulic engineering. *Water resources bulletin*, 24(2).