Original Article: The Need to Use Optimization in Water Resources Systems

Minoo Akhtarian Zand*

Department of Environmental Engineering-Water and Wastewater Engineering, Qatar University, Qatar

Use yor device to scan and read the article online

Citation M. Akhtarian zand*, **The Need to Use Optimization in Water Resources Systems.** *J. Eng. Ind. Res.* 2022; 3(1):17-24.

https://doi.org/10.22034/jeires.2022.1.3

Article info:
Received: 14 August 2021
Accepted: 06 September 2021
Available Online: 17 September 2021
ID: JEIRES-2108-1051
Checked for Plagiarism: Yes
Peer Reviewers Approved by:
Dr. Behrouz Jamalvandi
Editor who Approved Publication:
Professor Dr. Mohammad Haghighi

Keywords:
Water Resources Management, National Development Goals, Watershed Natural Boundaries

ABSTRACT

The 21st century can be considered the world century of water and the main war of countries over the possession of world water resources. Because the Middle East and Africa region are one of the arid and water-scarce regions of the world, the countries of this region are facing a water shortage crisis. A crisis, if not settled, can cause many problems for nations. Increasing world population and increasing demand for water and food products are other reasons for the need to pay attention to water resources management activities. Macro water resources management policies, in fact, determine the relationship between development and how to use these resources with national development goals. The first step in formulating macro-policies for water resources management is to propose different options according to the limitations and comprehensive goals of water resources development and management. The principles that have been considered in the current structure of water resources management organizations, considered water resources as the main element of land management and sustainable development of the basin, which should be managed by a single organization in the natural boundaries of the catchment people's participation and cooperation is perhaps the most effective factor in the evolution of water resources management system.

Introduction

Unfortunately, in Iran, the optimal use of water as a culture has not yet found its special place, so achieving "relative balance" in the field of water supply and consumption is a basic and necessary principle, which is definitely possible with proper planning [1-5]. The set of measures that have been taken so far concerning agricultural, urban, and industrial water supply has been mainly in the field of water production and

***Corresponding Author:** Minoo Akhtarian zand, (minoo.akhzand1983@gmail.com)

supply management and less attention has been paid to consumption management [6-8]. Rapid population growth and the growing need for resources and products, especially non-renewable resources such as water, require governments to pay attention to planning to control consumer demand [9-12].

Today, water is one of the three factors in the formation and survival of the environment. Undoubtedly, the preservation and protection of water resources and the optimal, economical and equitable use of water is a global issue today, and therefore in the 21st century, water is mentioned as a pervasive human challenge [13-15]. The world is for governments and nations to look at water as the key to development [16]. Although water resources are renewable, their volume is constant and, in contrast, human demand for them is increasing so that global demand has increased over the last 100 years [17-19]. For water, it has more than tripled while the population has tripled. In this way, the per capita water for the people of the world is decreasing, and on the other hand, unfortunately, pollutants such as industrial effluents, agricultural drains, and urban and rural wastewater pollute water resources and take them out of consumption standards [20-22]. Therefore, the optimal use of water resources is very important. In addition to the need for optimal operation and to develop methods to increase the confidence of users and managers due to the complexity of water resources systems, today the use of models has developed a lot and different types of models are used in micro and macro decisions of water resources systems [23-26]. In addition to using the existing set of models, there are many opportunities and challenges for managers and planners who, by recognizing them and using them properly, can take very effective steps in using the most up-to-date knowledge and applying it in the service of water supply [27-29].

Planning, designing, and managing water resources systems to achieve sustainable development goals in an area requires public participation [30-33]. All those involved in the development and management of water resources must always evaluate the effects of the system on economic, social, as well as environmental changes [34-36]. To achieve sustainable development, the issue of sustainability in all dimensions of planning, design, construction, and operation must be considered [37-39]. Economic and environmental analyses should not only consider the stage of development, operation, and maintenance of the system, but also the possibility of its destruction and the need for its replacement [40].

The need to use optimization in water resources systems

Water resources management activities can be divided into three categories: Formulating water resources management policies, management actions to achieve policy goals, and evaluating their effects [41-43]. Macro water resources management policies, in fact, determine the relationship between development and how to use these resources with national development goals [44-46]. The first step in formulating macro-policies for water resources management is to propose different options according to the limitations and comprehensive goals of water resources development and management [47-49]. The principles that have been considered in the current structure of water resources management organizations, consider water resources as the main element of land management and sustainable development of the basin, which should be managed by a single organization in the natural boundaries of the catchment people's participation and cooperation is perhaps the most effective factor in the evolution of water resources management system [50-53]. This partnership can be considered mainly in two areas of investment in water resources development projects and policy impact, which is an important issue [54-56]. The main reasons for water stress can be the following:

a) Limitation of available water resources and heterogeneous distribution of resources;

b) increasing population;

c) increasing the vulnerability of different water supply systems due to their complexity;

d) increasing the per capita water consumption due to increasing the level of welfare and health of the people [57].

e) increasing the need in different industrial and agricultural sectors according to the development process of these sectors [58];

f) climate change and the need for long-term forecasts [59];

g) pollution of water resources; and

h) destruction of resources, especially groundwater due to over-harvesting and lack of proper management [60].

Increasing the vulnerability of different water supply systems

In many large cities, overtaking water needs from the total resources available in the area on the one hand and the mismatch between peak supply and peak consumption, on the other hand, has doubled the need for more accurate planning to meet needs and consumption management [61-63].

These challenges, along with the occurrence of periods of water shortage and wetting, as well as crises due to the failure of the supply system, transmission or distribution, and widespread pollution in the system, have doubled the need for specific policies and systems operation. To achieve this goal, it is necessary to increase the readiness of the system to deal with critical situations [64].

Lack of integrated exploitation of surface and groundwater resources

This is especially important in the case of groundwater resources. If groundwater resources are over-exploited, leading to the destruction of these resources and groundwater depletion. In many irrigation systems, groundwater is not used alone and may be available as a supplement to surface water. Therefore, integrated exploitation is one of the managerial analyses in the exploitation of water resources. Also, lack of proper management has caused water resources to be more susceptible to pollution than their self-purification capacity, and as a result, they have lost their potential for various uses and are practically unusable [65].

Challenges and opportunities in using optimization models in water resources management

One of the basic pillars of water resources management in the current situation is the optimal use of available resources. To consider the various dimensions and complexities of water resources systems, managers and planners today have resorted to using optimization models as an efficient tool to achieve optimal decisions [66-68].

A variety of evolutionary, deterministic and non-deterministic, static and dynamic, linear and nonlinear optimization models are used in various aspects of water resources management. The development of human knowledge and the creation of new tools and their combination with existing optimization models have provided new opportunities for better decision-makers in the development and planning of water resources. In the continuation of this section, we will deal with these opportunities and challenges [69-71].

Creating tools and the need for access to modern technology such as the World Wide Web and GIS Information value of new data and information due to behavioral changes in watersheds and the importance of rapid use of this information for analysis, design, and information in emergencies and public education and consumption water conservation has created new coordinates in water resources management [72-74].

Today, with the rapid development of information technology, a new space has been provided for the development of new tools for the analysis, planning, and management of water resources systems. With access to the Internet, an infinite space of information and science is provided to the user, which can be used to make the most effective decisions. Useful tools that have been significantly expanded include

remote sensing and GIS. Using remote sensing, quantitative and qualitative variables can be identified and effective parameters about them can be measured and the relationships between them can be interpreted. For example, using the information of sensors in aircraft and satellites, valuable information such as soil moisture, snow cover, and flood spread can be obtained, which are of great importance in water resources management [75-77].

Reasons for differences and the expansion of public knowledge to participate in the optimization process

There are always problems in the decision-making process of water resources management due to the existence of different sectors that consume and produce wastewater, because different sectors have different goals, views, and priorities, and the final decision should be in such a way that all these disagreements should be observed. Limited resources and increasing water demand, which is due to population growth and development of cities and new community management policies, cause problems in water allocation. By knowing more and more about the reasons for the differences and modeling them using different methods and including them in the optimization models, we can be very confident that the results of the developed model are feasible and practical [78]. Cooperation and participation of different departments in the preparation and formulation of water resources management policies, facilitate the management and implementation of policies in water management and also reduce disputes. Increasing the level of knowledge and public awareness in relation to issues, points, and areas in optimization has led to improving the process of these partnerships.

By changing the patterns, there is a need for new tools and methodologies related to water supply and consumption management that, while reflecting the complexities of the system, are able to develop and measure the stability of the system now and in the future. These new tools use a systematic perspective. A systems perspective is a type of systemic attitude and thinking that allows for better identification of issues, problems, and shortcomings, and facilitates understanding and analysis. The system view is in contrast to the detail view and seeks to examine the goals of collections and systems with the help of modeling and effective use of information and management tools [79].

The need to manage water demand in Iran

Water shortage in Iran is one of the main limiting factors for the development of economic activities in the coming decades, but unfortunately in our country has not yet found its proper use of water as a culture, so achieving relative balance in the field of water supply and consumption is a basic and necessary principle, which is not possible except by creating a comprehensive water management system. The set of measures taken so far in the country about agricultural, urban, and industrial water supply, mainly in the field of management has been the production and supply of water and less attention has been paid to consumption management [80-82]. In the new global view, water is considered as a socio-economic commodity and as a basic human need. Although water is a renewable resource, its amount is limited. Due to population growth, industry expansion, rising public health, and welfare, per capita, renewable resources are declining [83].

Iran is one of the driest countries in the world with an average rainfall of 260 mm per year and has limited water resources. Factors such as population growth, the need for more food, the need to improve health and social welfare, industrial development, and ecosystem protection, increase the demand for water day by day. Due to population growth in Iran, the annual per capita renewable water resources, which was 7,000 cubic meters in 1956, decreased to 2,000 cubic meters in 1994 and is expected to decrease to about 800 cubic meters by 2021, which is lower than the limit of water shortage (1000 cubic meters) [84].

World Bank report reflects on per capita reduction of extractable water and loss of its quality, inefficient use of consumption

monitoring efficiency in agricultural, industrial, and agricultural sectors, unsatisfactory state of repairs and maintenance, limited compensation and lack of coordination between relevant organizations, as the challenges facing the country's water. Uneven distribution of water throughout the place and time, the existence of the highest water demand at the time of the least rainfall, the imbalance between Water supply and demand, especially the increase in water demand due to the reasons mentioned and limited water resources and in some places its reduction by degrading groundwater aquifers due to over-harvesting, saline water advance, improper disposal of domestic wastewater and industrial effluents, rising costs of new water supply with fierce competition among water consumers due to limited water resources, inefficient use of water, high water loss in the agricultural sector and unaccounted for high water in the urban sector, and inefficient pricing mechanisms are of major problems [85]. There are other water problems that have complicated the management of the country's water resources. For more than two decades, the world has realized that in managing water resources, more attention should be paid to demand management than supply management. To this end, scientists have proposed integrated water management. Integrated management has two general policies and one main goal. Integrated management policies include the following items: a) Water should be treated as an economic, social, and environmental commodity, and b) policies and options that guide water management should be analyzed in an integrated framework. The main goal of integrated management is to achieve sustainable, efficient, and equitable development of water resources through integrated water management. Therefore, the principles of integrated management are based on the combination of supply management with demand management, which takes into account environmental, social and economic aspects. In general, all measures that affect the quality and quantity of water entering a consumption system are part of management.

In other words, water demand management refers to activities that help reduce water demand, improve consumption efficiency and prevent contamination or destruction of resources. In demand management, water reduction is not considered, network pressure is reduced, type of water distribution system in the city, modification of home water piping system, use of parts and devices to reduce water consumption, water pricing, and training to save water consumption in the city are appropriate methods to reduce demand and water consumption that should be through legal means, technical, financial, as well as public awareness and education program to be actively and continuously pursued. Behaviors or behavioral intentions of people to save water consumption depends on their attitude and level of awareness about water issues. For water demand management activities to be implemented successfully, it is necessary to improve people's awareness and attitudes towards saving water consumption to increase their cooperation in the implementation of these programs.

Conclusion

In this paper, the necessity of using optimization models in water resources management due to the complexity of these systems in the present conditions was investigated. In addition to the common use of optimization models to address resource tensions, the existing opportunities and challenges to develop the use of these models and combine them with modern management and information systems should also be considered and used. In this regard, the main opportunities in this field have been examined and the sample of tools produced in each section have also been examined. Among the existing challenges, the following can be mentioned as the main points: Development of access to information and advanced information management systems, expansion of human knowledge with understanding processes and relationships between different system components and phenomena, increasing public knowledge to apply optimization guidelines, increasing the ability to quantify various qualitative parameters of resource management such as differences, uncertainties and

uncertainties and how to deal with them. According to the presented materials, it can be concluded that despite the many advances that the comprehensive management of water resources there areambiguous aspects such as cultural, political, and social aspects. To achieve the realistic goals of holistic management of water resources, it is necessary to identify them in optimized models of water resources utilization.

References

[1] A. Bozorgian, *Advanced Journal of Chemistry, Section B: Natural Products and Medical Chemistry*, **2021**, *3*, 54-61. **[crossref], [Google Scholar], [Publisher]**

[2] A. Haghighi Asl, A. Ahmadpour, N. Fallah, *Applied Chemistry*, **2017**, *12*, 253-286. **[crossref], [Google Scholar], [Publisher]**

[3] A. Bozorgian, A. Samimi, *International Journal of New Chemistry*, **2021**, *8*, 41-58. **[crossref], [Google Scholar], [Publisher]**

[4] E.A. Mahdiraji, N. Ramezani, *International Journal of Science and Engineering Investigations (IJSEI)*, **2020**, *9*, 24-28. **[Google Scholar], [Publisher]**

[5] E. Amouzad Mahdiraji, N. Ramezani, *Signal Processing and Renewable Energy*, **2020**, *4*, 37-50. **[Google Scholar], [Publisher]**

[6] E.A. Mahdiraji, N. Ramezani, *International Journal of Science and Engineering Investigations (IJSEI)*, **2020**, *9*, 35-42. **[Google Scholar], [Publisher]**

[7] E. Amouzad Mahdiraji, M. Sedghi Amiri, *Journal of Engineering in Industrial Research*, **2021**, *2*, 7-16. **[crossref], [Google Scholar], [Publisher]**

[8] E. Amouzad Mahdiraji, *CRPASE: Transactions of Electrical, Electronic and Computer Engineering*, **2020**, *6*, 245–250. **[Google Scholar], [Publisher]**

[9] E. Amouzad Mahdiraji, A. Yousefi Talouki, *Journal of Chemical Reviews*, **2021**, *3*, 40-49. **[crossref], [Google Scholar], [Publisher]**

[10] E. Amouzad Mahdiraji, *CRPASE: Transactions of Electrical, Electronic and Computer Engineering*, **2020**, *6*, 238–244. **[Google Scholar], [Publisher]**

have been made in the use of optimization models in water resources management, still in

[11] E.A. Mahdiraji, *Gazi Mühendislik Bilimleri Dergisi (GMBD)*, *6*, 138-144. **[Google Scholar], [Publisher]**

[12] E. Amouzad Mahdiraji, *Journal of Chemical Reviews*, **2021**, *3*, 147-159. **[crossref], [Google Scholar], [Publisher]**

[13] E.A. Mahdiraji, M. Amiri, *Journal of Engineering Technology and Applied Sciences*. **2020**, *5*, 133-147. **[crossref], [Google Scholar], [Publisher]**

[14] E.A. Mahdiraji, *Journal of Scientific Perspectives*, **2020**, *4*, 245-254. **[crossref], [Google Scholar], [Publisher]**

[15] E. Amouzad Mahdiraji, M. Sedghi Amiri. *International Journal of Smart Electrical Engineering*, **2020**, *9*, 13-21. **[Google Scholar], [Publisher]**

[16] E.A. Mahdiraji, S.M. Shariatmadar, *Advanced Journal of Science and Engineering*, **2020**, *1*, 27-31. **[crossref], [Google Scholar], [Publisher]**

[17] E. Amouzad Mahdiraji, S. Shariatmadar, *International Journal of Smart Electrical Engineering*, **2019**, *8*, 143-148. **[Google Scholar], [Publisher]**

[18] E.A. Mahdiraji, A. Yousefi Talouki, *Journal of Chemical Reviews*, **2020**, *2*, 284-291. **[crossref], [Google Scholar], [Publisher]**

[19] E. Amouzad Mahdiraji, S. Shariatmadar, *International Journal of Smart Electrical Engineering*, **2019**, *8*, 51-58. **[Google Scholar], [Publisher]**

[20] E. A. Mahdiraji, N. Ramezani, In 2015 *2nd International Conference on Knowledge-Based Engineering and Innovation (KBEI)*, **2015**, 405-411. **[crossref], [Google Scholar], [Publisher]**

[21] E. Amouzad Mahdiraji, S. Shariatmadar, *International Journal of Smart Electrical Engineering*, **2019**, *8*, 99-104. **[Google Scholar], [Publisher]**

[22] E. Amouzad Mahdiraji, M. Sedghi Amiri, *Quantum Journal of Engineering, Science and Technology*, **2021**, *2*, 1–15. **[Google Scholar], [Publisher]**

[23] E.A. Mahdiraji, N. Ramezani, *International Journal of Mechatronics,*

Electrical and Computer Technology (IJMEC), **2015**, *5*, 2585-2600. **[Google Scholar], [Publisher]**

[24] E. Amouzad Mahdiraji, S. Mohammadi Shah Kilah, A.S. Hosseini, *ÖRGÜTSEL DAVRANIŞ ARAŞTIRMALARI DERGİSİ*, **2018**, *3*, 2528-9705. **[Google Scholar], [Publisher]**

[25] E. Amouzad Mahdiraji, M. Sedghi Amiri, *Advanced Journal of Science and Engineering*, **2021**, *2*, 42–50. **[crossref], [Google Scholar], [Publisher]**

[26] E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 178-193. **[crossref], [Google Scholar], [Publisher]**

[27] M. Sedghi Amiri, E. Amouzad Mahdiraji, *Journal of Science and Technology Research*, *2021*, *1*, 11-19. **[crossref], [Google Scholar], [Publisher]**

[28] E. Amouzad Mahdiraji, *Journal of Science and Technology Research*, **2021**, *1*, 40-47. **[crossref], [Google Scholar], [Publisher]**

[29] R. Kolbadinezhad, E. Amouzad Mahdiraji. *Journal of Science and Technology Research*, **2021**, *1*, 75-82. **[crossref], [Google Scholar], [Publisher]**

[30] E.A. Mahdiraji, M. Sedghi Amiri. *Journal of Science and Technology Research*, **2021**, *1*, 89-103. **[crossref], [Google Scholar], [Publisher]**

[31] R. Kolbadinezhad, E. Amouzad Mahdiraji. *Journal of Science and Technology Research*, **2021**, *1*, 131-141. **[crossref], [Google Scholar], [Publisher]**

[32] E.A. Mahdiraji, R. Kolbadinezhad. *Journal of Science and Technology Research*, **2021**, *1*, 142-149. **[crossref], [Google Scholar], [Publisher]**

[33] E.A. Mahdiraji. *Journal of Engineering in Industrial Research*, **2021**, *2*, 202-209. **[crossref], [Google Scholar], [Publisher]**

[34] S.M. Shariatmadar, E.A. Mahdiraji. *Journal of Engineering in Industrial Research*, **2021**, *2*, 210-217. **[crossref], [Google Scholar], [Publisher]**

[35] K.A. Mahdiraji, E.A. Mahdiraji. *Journal of Engineering in Industrial Research*, **2021**, *2*, 228-233. **[crossref], [Google Scholar], [Publisher]**

[36] E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 234-251. **[crossref], [Google Scholar], [Publisher]**

[37] E.A. Mahdiraji. *Journal of Science and Technology Research*, **2021**, **1**, 234-241. **[crossref], [Google Scholar], [Publisher]**

[38] A. Amini, H. Shahpoori Arani, M. Milani Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 421-424. **[crossref], [Google Scholar], [Publisher]**

[39] A.M.M. Fard, M.M. Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 384-398. **[crossref], [Google Scholar], [Publisher]**

[40] A. Samimi, *International Science and Investigation journal*, **2014**, *3*, 57-64. **[crossref], [Google Scholar], [Publisher]**

[41] A. Samimi, *Journal of Engineering in Industrial Research*, **2021**, *2*, 71-76. **[crossref], [Google Scholar], [Publisher]**

[42] A. Susanabadi, M.S. Sadri, H. Taleby, S. Etemadi, B. Mahmoodiyeh, M.M. Fard, *Annals of the Roma-nian Society for Cell Biology*, **2021**, *25*, 2703-2716. **[Google Scholar], [Publisher]**

[43] A. Susanabadi, S. Etemadi, M.S. Sadri, B. Mahmoodiyeh, H. Taleby, M.M. Fard, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2875–2887. **[Google Scholar], [Publisher]**

[44] A. Yarahmadi, K. Kamrava, A. Shafee, M.M. Fard, M. Aghajanpour, A. Mohebbi, *Journal of Pharmaceutical Research International*, **2020**, *31*, 1-6. **[crossref], [Google Scholar], [Publisher]**

[45] A. Bozorgian, S. Zarinabadi, A. Samimi, *Journal of Chemical Reviews*, **2020**, *2*, 122-129. **[crossref], [Google Scholar], [Publisher]**

[46] A.M.M. Fard, M.M. Fard, *Journal of Science and Technology Research*, **2021**, *1*, 284-301. **[crossref], [Google Scholar], [Publisher]**

[47] A.M.M. Fard, M.M. Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 384-398. **[crossref], [Google Scholar], [Publisher]**

[48] A.M.M. Fard, M.M. Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 284-301. **[crossref], [Google Scholar], [Publisher]**

[49] A.O. Shirazi, H. Jahandideh, A. Yarahmadi, M.M. Fard, M.M. Delarestaghi,

Medical Science, **2020**, *24*, 2467-2474 **[crossref], [Google Scholar], [Publisher]**

[50] B. Mahmoodiyeh, S. Etemadi, A. Kamali, S. Rajabi, M.M. Fard, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2559–2572. **[Google Scholar], [Publisher]**

[51] Barmasi, *Journal of Engineering in Industrial Research*, **2020**, *1*, 161-169. **[crossref], [Google Scholar], [Publisher]**

[52] A. Bozorgian, *Journal of Engineering in Industrial Research*, **2020**, *1*, 1-18. **[crossref], [Google Scholar], [Publisher]**

[53] E.S. Motaharian, B. Mahmoodiyeh, S. Lorestani, M.S. Sadri, M.M. Fard, A.M.M. Fard, A. Amini, *Journal of Chemical Reviews*, **2021**, *3*, 171-180. **[crossref], [Google Scholar], [Publisher]**

[54] E.A. Mahdiraji, M. Sedghi Amiri, *Journal of Engineering in Industrial Research*, **2020**, *1*, 111-122. **[crossref], [Google Scholar], [Publisher]**

[55] A. Bozorgian, *Journal of Engineering in Industrial Research*, **2020**, *1*, 1-19. **[crossref], [Google Scholar], [Publisher]**

[56] F. Zabihi, M.A. Abbasi, R. Alimoradzadeh, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2573–2579. **[Google Scholar], [Publisher]**

[57] F. Gharekhani Kasa, *Journal of Engineering in Industrial Research*, **2020**, *1*, 51-74. **[crossref], [Google Scholar], [Publisher]**

[58] F. Rebout, *Journal of Engineering in Industrial Research*, **2020**, *1*, 19-37. **[crossref], [Google Scholar], [Publisher]**

[59] F. Zare Kazemabadi, A. Heydarinasab, A. Akbarzadeh, M. Ardjmand, *Artificial cells, nanomedicine, and biotechnology*, **2019**, *47*, 3222-3230. **[crossref], [Google Scholar], [Publisher]**

[60] F. Zare Kazemabadi, A. Heydarinasab, A. Akbarzadehkhiyavi, M. Ardjmand, Chemical Methodologies, **2021**, *5*, 135-152. **[crossref], [Google Scholar], [Publisher]**

[61] M. Bagheri sadr, A. Bozorgian, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 252-261. **[crossref], [Google Scholar], [Publisher]**

[62] H. Jahandideh, A. Yarahmadi, S. Rajaieh, A. Ostvar Shirazi, M.M. Fard, A. Yarahmadi, *Journal of Pharmaceutical Research International*, **2019**, 1-7. **[crossref], [Google Scholar], [Publisher]**

[63] E. Amouzad Mahdiraji, *Signal Processing and Renewable Energy*, **2020**, *4*, 67-80. **[Google Scholar], [Publisher]**

[64] M.M. Fard, A. Amini, M. Shafie Aghol, *Eurasian Journal of Science and Technology*, **2021**, *1*, 399-411. **[crossref], [Google Scholar], [Publisher]**

[65] M.M. Fard, A.M.M. Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 365-383. **[crossref], [Google Scholar], [Publisher]**

[66] M.M. Fard, A.M.M. Fard, *Eurasian Journal of Science and Technology*, **2021**, *1*, 271-283. **[crossref], [Google Scholar], [Publisher]**

[67] M. Mokhtare, R. Alimoradzadeh, S. Agah, H. Mirmiranpour, N. Khodabandehloo„ *Middle East journal of digestive diseases*, **2017**, *9*, 228. **[crossref], [Google Scholar], [Publisher]**

[68] M. Rohani, H.R.B. Baradaran, A. Sanagoo, M. Sarani, S. Yazdani, H.R. Alizadeh, *Razi journal of medical sciences*, **2016**, *23*, 115-124. **[crossref], [Google Scholar], [Publisher]**

[69] M. Zbuzant, *Journal of Engineering in Industrial Research*, **2020**, *1*, 75-81. **[crossref], [Google Scholar], [Publisher]**

[70] M.M. Fard, A.M.M. Fard, *Journal of Science and Technology Research*, **2021**, *1*, 365-383. **[crossref], [Google Scholar], [Publisher]**

[71] R. Alimoradzadeh, H. Mirmiranpour, P. Hashemi, S. Pezeshki, S.S. Salehi, *Journal of Neurology & Neurophysiology*, **2019**, *10*, 1-5. **[crossref], [Google Scholar], [Publisher]**

[72] R Alimoradzadeh, M Mokhtare, S Agah, *Iranian Journal of Ageing*, **2017**, *12*, 78-89. **[crossref], [Google Scholar], [Publisher]**

[73] R. Alimoradzadeh, M.A. Abbasi, F. Zabihi, H. Mirmiranpour, *Iranian Journal of Ageing*, **2021**, *15*, 524-533. **[crossref], [Google Scholar], [Publisher]**

[74] S Etemadi, B Mahmoodiyeh, S Rajabi, A Kamali, M Milanifard, *Annals of the Romanian Society for Cell Biology,* **2021**, *25*, 2417-2426. **[crossref], [Google Scholar], [Publisher]**

[75] S. Zarinabadi, A. Esfandiyari, S.A. Khoddami, A. Samimi, *Journal of Fundamental and Applied Sciences*, **2016**, *8*, 1133-1149. **[crossref], [Google Scholar], [Publisher]**

[76] S. Zarinabadi, A. Samimi, *Journal of Fundamental and Applied Sciences*, **2016**, *8*, 1160-1172. **[crossref], [Google Scholar], [Publisher]**

[77] S.A. Mirmalek, F. Tirgari, H.R. Alizadeh, *Iranian Journal of Surgery*, **2005**, *13*, 48-54. **[crossref], [Google Scholar], [Publisher]**

[78] S.M.S. Mirnezami, F. Zare Kazemabadi, A. Heydarinasab, *Progress in Chemical and Biochemical Research*, **2021**, *4*, 191-206. **[crossref], [Google Scholar], [Publisher]**

[79] M. Bagheri Sadr, A. Bozorgian, *Journal of Chemical Reviews*, **2021**, *3*, 66-82. **[crossref], [Google Scholar], [Publisher]**

[80] M. Bagheri Sadr, A. Bozorgian, *Journal of Chemical Reviews*, **2021**, *3*, 66-82. **[crossref], [Google Scholar], [Publisher]**

[81] A. Bozorgian, *Journal of Chemical Reviews*, **2021**, *3*, 50-65. **[crossref], [Google Scholar], [Publisher]**

[82] N. Kayedi, A. Samimi, M. Asgari Bajgirani, A. Bozorgian, *South African Journal of Chemical Engineering*, **2021**, *35*, 153-158. **[crossref], [Google Scholar], [Publisher]**

[83] S.V. Mousavi, A. Bozorgian, N. Mokhtari, M.A. Gabris, H.R. Nodeh, *Microchemical Journal*, **2019**, *145*, 914-920. **[crossref], [Google Scholar], [Publisher]**

[84] E. Amouzad Mahdiraji, M. Sedghi Amiri, *Journal of Engineering in Industrial Research,* **2020**, *1*, 111-122. **[crossref], [Google Scholar], [Publisher]**

[85] A. Bozorgian, *Chemical Review and Letters*, **2020**, *3*, 79-85. **[crossref], [Google Scholar], [Publisher]**