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Watershed Management Sciences and Engineering Conference in Iran: History and Highlights

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ABSTRACT

Aims Aim of the present study is to describe the history and outcomes of the Iranian Conference on Watershed Management Sciences and Engineering (WMSE) from 1973 to 2019.

Instruments & Methods The archives of 14 WMSE conferences were first collected. Then, important information was derived and analyzed. 25 questionnaires were also analyzed.

Findings The WMSE conference activities interrupted from late-1970s to early 1990s because of the Iran-Iraq war, Iranian Cultural Revolution and closure of the universities. Then, after 18 years from the 3rd WMSE conference, the Watershed Management Society of Iran (WMSI) decided to continue holding the series of watershed management conferences. According to the analysis of the last 11 conferences, 2794 papers with 5029 authors have been presented. In total, 2635, 2177, and 47 students respectively with PhD, MSc, and BSc students were contributed. In addition, 862 and 238 contributions were respectively made from university and research institute parts. The temporal pattern of number of papers published in the WMSE conference showed a cyclic pattern during 11 conferences which increased one and a half times (i.e., 54%) in seven years from 2008 to 2014, followed by a sharp decline in 2016 (71%; Yasouj City) and 2017 (77%; Malayer City).

Conclusion Despite a large number of papers presented in the WMSE conferences, knowledge about the watershed governance needs to be improved. It was proved that 48, 32, 16, and 4% of the WMSE contributors respectively anticipated the medium, good, bad, and very bad future for WM state in the country.

Keywords Environmental Issues; Management of Watersheds; Natural Resources; Research Trend; Watershed Management Society of Iran

CITATION LINKS

[1] Integrated watershed management ... [2] Watershed management in ... [3] New strategies for America's ... [4] Developing a semi-distributed decision ... [5] Suitability assessment of rural settlement ... [6] SWAT-simulated ... [7] Determining the monthly utilizable water ... [8] Changeability of reliability, resilience ... [9] Health comparative comprehensive ... [10] Land cover based ... [11] Mapping watershed integrity for ... [12] Towards integrated governance ... [13] Monitoring, restoration, and ... [14] Potential effects of vinasse as a ... [15] Watershed prioritization based on ... [16] Ecohealth and watersheds ... [17] Empowering the next ... [18] Sustainable watershed management through ... [19] Reliability of land capability map in ... [20] Prioritizing of the Sub-watersheds ... [21] Integrated watershed ... [22] Land stewardship through ... [23] Tehran: Forests, Range and ... [24] Tehran: Ministry of ... [25] Selection of representative... [26] Gorgan: watershedmg ... [27] Development of a National ... [28] Paris: www.en.unesco ... [29] The Hague: euwma ... [30] nrcs.usda ... [31] www.waswac ... [32] soilconservation ... [33] iwa-network ... [34] wmao.clubexpress ... [35] Saint Paul: Minnesota ... [36] Tehran: Ministry of Science ... [37] Kerman: Shahid ... [38] Tehran: Iranian Society for Range ... [39] Tehran: Iranian Rainwater ... [40] Tehran: Soil Science Society of ... [41] Tehran: Watershed ... [42] The cultural revolution in Iran ... [43] Iranian Soil Science ... [44] Tehran: National Development Fund of Islamic ... [45] Iran's population ... [46] Tehran: Watershed Management ... [47] Tehran: Iranian Journal of ... [48] Sari: Sari Agricultural Sciences and ... [49] Tehran: Iranian Journal of Watershed ... [50] Tehran: Extension and ... [51] Tehran: Iranian Journal ... [52] Iran's socio-economic ... [53] Irrigation in the Middle East region ... [54] Combating desertification in ... [55] Land degradation ... [56] Local water governance ... [57] Challenges facing ... [58] Scenario analysis for integrated ... [59] Future studies of water crisis ... [60] The survey of climatic drought ... [61] Assessment of climate change impacts ... [62] Trend analysis of the ... [63] Spatiotemporal variation ... [64] Assessing hydrological effects of Jafar-Abad ... [65] From risk to resilience ...

Introduction

Watersheds are discerned as the most appropriate geographical units and spatial constructs for integrated land management [1-3] in terms of different aspects of water resources [4], land use management [5], hydrological process assessment [6, 7], health [8-10], integrity [11], sustainability [12], monitoring [13], conservation and restoration [14], prioritization [15] and well-being [16]. Towards this, watershed management (WM) is a challenging issue for global, national, and local decisions and policymakers [17-20]. A comprehensive definition of WM given by Wang *et al*. [21] as "the process of organizing and guiding land, water, and other natural resources used in a watershed to provide the appropriate goods and services while mitigating the impact on the soil and watershed resources". In this definition, the interactive effects of social, economic, institutional, and biophysical are considered, too [22]. Implementation of WM measures has a long history. However, its holistic concept has been merged in the mid-20th century.

The first generation of WM approaches was technology-driven and was popular during the 1960s up to 1980s. The second generation of WM approaches can be called "participatory watershed approaches" and used real bottom-up approaches. Such projects were initiated by non-governmental organizations (NGOs) during 1980s. Donors and government agencies started to use this approach from 1990s onwards. The third generation of WM approaches is called "collaborative watershed approaches". Such projects have involved multi-stakeholder processes and joined "bottom-up" and "top-down" approaches. This approach started since 2000 and is now being tested at many sites around the world [6]. The concept of WM is officially developed in 1949 in Iran, via establishing the water and soil surveys and resource conservation offices at the Ministry of Agriculture. It is well documented that Iran, where located in West Asia has a long history of WM (special traditional methods) to deal with different problems caused by floods, primarily via engineering structures such as dams, levees, and reservoirs [2]. Currently, the Deputy of Watershed Management, Rangeland and Desert Affairs in the Forests, Range and Watershed Management Organization of Iran (FRWMO) [23], which is one of the main organizations of the Ministry of Agriculture-Jihad [24], is responsible for WM activities in the country. As depicted in Figure 1 [25], six main basins viz. Mazandaran, Persian Gulf, and Oman Sea, Urmia Lake, Central Plateau, Hamoon and Gharqhoom and consequently, 30 sub-basins are formed the total land area of Iran [23].

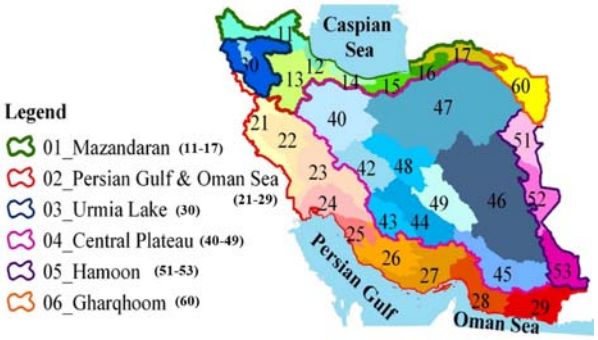

Figure 1) General view from main sub-basins (Code: 01-06) and their main watersheds, Iran

In the past seven decades (1949-2019) noteworthy changes have ensued considering natural resources via national and global WM programs. Governmental and non-governmental institutions have made many efforts to identify the best management strategies applicable to watershed scale in different socio-economic and physiographic conditions of the country. International projects supervised by different organizations such as Global Environment Facility Fund (GEF), United Nations Development Program (UNDP), United Nations Environment Program (UNEP), Japan International Cooperation Agency (JICA), International Fund for Agricultural Development (IFAD), and United Nations High Commissioner for Refugee Agency (UNHC) have launched also to manage the Iranian watersheds in different viewpoints. Development of National Mega Project on the Integrated Watershed Management [26] has been considered as an important turning point in the field of natural resources management in Iran. It has been approved by the Supreme Council for Science, Research, and Technology, Ministry of Education, Research and Technology of Iran in participation with FRWMO and Ministry of Agriculture-Jihad. The conceptual framework of the project is going to be implemented in 30 pilot watersheds across the country in line with the sustainable development goals [27].

At the global level, the significant role of non-governmental organizations (NGOs) was approved in the information, education, communication, and social mobilizing activities.

In addition, the NGOs those related to soil and water issues play an important role in management, restoration and conservation of natural resources and environmental ecosystem. A list of some NGOs was addressed by The United Nations Educational, Scientific and Cultural Organization (UNESCO) [28] and the European Union of Water Management Associations (EUWMA) [29]. Globally, there are several associations focusing on the natural resources including watershed management such as National Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS) [30], World Association of Soil and Water Conservation [31], European Society for Soil Conservation [32], International Water Association [33], Water Management Association of Ohio (WMAO) [34] and Watershed Management Organization (WMO) of Minnesota [35]. In addition, in Iran 44 scientific associations associated with agriculture and natural resources were recorded [36]. For example, Iranian Society of Irrigation & Water Engineering [37], Iranian Society of Range Management [38], Iranian Rainwater Catchment Systems Association [39], Soil Science Society of Iran (SSSI) [40] and Watershed Management Society of Iran [41]. As cited in the homepages of these well-known organizations, they achieve their short- and long-term goals by organizing workshops, seminars, field trip, conferences and etc.

The base framework of the Iranian NGOs is almost similar as the WMSI will be explained in details. Other NGOs frameworks are dependent on the general conditions and facilitations are provided in their country. For example, the Water Management Association of Ohio (WMAO) at Midwestern U.S. state is served Ohio by promoting effective management of water resources for nearly 50 years. WMAO is the only professional organization in Ohio focused on all water disciplines, administered through five divisions and multiple interest areas. WMAO provides a forum of open discussion, industry evaluation, and educational outreach for its diverse membership to communicate and learn. WMAO is a statewide nonprofit with five divisions to offer programming specific to a water discipline: Ohio Watershed Professionals Association (OWPA), Ohio Dam Safety Organization (ODSO), Ohio Floodplain Management Association (OFMA), Ohio Lake Management Society (OLMS), and Ohio Stormwater Association (OSWA). There are 12 interest areas for dissemination of information and networking that address all water resources and professional activity within Ohio including agriculture, dam safety, drinking water-wastewater, education, floodplain management, groundwater, lake management, mineral resource management, research and data, storm water, navigation and recreation and watersheds. The WMAO board of directors are formed by 20 persons with different roles of President, Vice President, Past President, Secretary, Treasurer, Division Director-ODSO, Division Director-OFMA, Division Director-OLMS, Division Director-OSWA, Division Director-OWPA, Director-Agriculture, Director-Education, Director-Groundwater, Director-Mineral Resource Management, Director-Navigation & Recreation, Director-Research & Data Management, Director-Water & Wastewater, Director-at-Large (Two persons) and Affiliated Student Organization [34].

The Watershed Management Society of Iran (WMSI) as an NGO with license No. 10285 has been the national and international importance in the early development of WM in Iran. The WMSI began its activities in 1998 with over 500 members from university professors and researchers working on soil and water issues. The WMSI has been formed 21 years ago to promote science and enhance the knowledge level of the members qualitatively and quantitatively in this field. WMSI believed that the absence of proper coordination among the related education, scientific and executive governmental institutions with WM, are the main obstacles of the successfulness and sustainability of most development projects. Towards this, since 2008 the WMSI has been tried to organize the Iranian Conference on Watershed Management Sciences and Engineering (WMSE) to provide an appropriate space to communicate different stockholders, partners and even local communities in WM decisions. The tabulated and graphical results and analysis of the WMSE Conference will be very applicable to draw the best road map for adaption the managerial tools of watersheds overcoming the main issues of soil and water resources under the occurred drought events and climate change. Therefore, the present study aimed to assess the effectiveness of these conferences and to draw the history and outcomes of WMSE Conference from 1973 to

2019 in terms of different quantitative and qualitative criteria.

Instruments and Methods

To obtain the main objective of the present study, the hard- and soft-copy archives of 14 WMSE conferences were first collected. Then, the important information like the holding year, location, conference header, main themes, sub-themes, total papers, percentage of contribution between universities and research institutes, WMSE student numbers, and male and female contributions for each conference were derived and then analyzed. The Microsoft Excel 2016 was used to draw the charts and some calculations, as well as IBM SPSS Statistics 25, was applied for the analysis of questionnaires.

All published papers in WMSE conferences were considered and the following information was extracted from the available archives (i) general information such as overview of WMSE conferences, number of papers published during WMSE conferences, (ii) contribution of each province in compilation of papers, (iii) contribution of universities and research institutes in compilation of papers during different years and (iv) important issues discussed in WMSE conferences. Moreover, a questionnaire was designed to collect the opinion of different Iranian WM scientists about the current and future status of WM in Iran. Totally, 25 questionnaires were distributed through professors and experts who have been presented in 14th WMSE conference, Urmia, on July 16 and 17, 2019.

Findings and Discussion

WMSE conferences history

WMSE conference is a national conference that started in 1973 and mainly sponsored by the WMSI from 2008. The spatial distribution of WMSE conference from 1973 to 2019 is shown in Figure 2. According to analysis obtained from the proceeding books, it was found that the objectives of the WMSE conference mainly were to gather researchers from various places of the country and even other countries lead to preparing a unique opportunity to present research findings to an exclusive audience (a), to report on the latest research achievements and developments (b), to facilitate constructive exchange of information, ideas, research findings, best practices, and experiences identified between the researchers and practitioners (c), to strengthen academic exchanges and establish professional networks (d), to promote cooperation in science and technology in regards to the progress in WM and natural resources sciences (e).

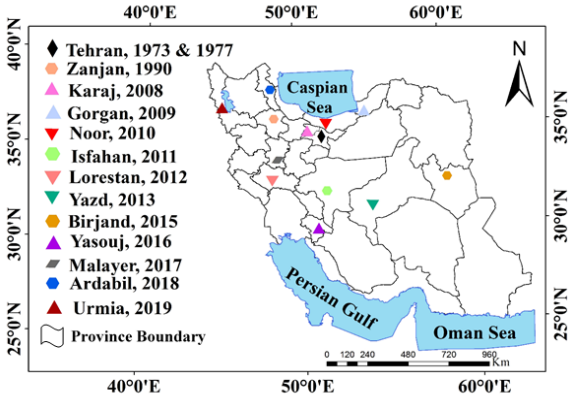

Figure 2) General view from the spatial distribution of WMSE conference locations (city) from 1973 to 2019

Over the past 46 years, 14 WMSE conferences were held at different universities and research institutes of Iran (Table 1). The University of Tehran, which is the oldest and the most prestigious Iranian university, was selected as the meeting place for the first and second WMSE conferences respectively in 1973 and 1977. The WMSE conferences activity interrupted from the late-1970s to early 1990s because of Iran-Iraq war, Iranian Cultural Revolution and closure of the universities [42] which the same condition for Iranian Soil Science Congress (ISSC) also was reported [43]. Then, the third WMSE conference was held in 1990 in Zanjan with the responsibility of Watershed Management Department of Zanjan Province focusing on "Challenges of Natural Resources". Thenceforward, after 18 years from the third WMSE conference, the WMSI continued holding of WMSE conferences. It is important to say that, the full name of WMSE was originated from 2008, and since this time, it is tried to be held annually (Table 1).

As Table 1 shows, every conference is based on the main theme that covered various WM and natural resources issues and organizers efforts to focus the researcher's mind on these concepts and to discuss them. Table 1 showed the WMSE conference themes were adapted to harmonize with many of the problems facing the world today. It is also should be mentioned that some WMSE conferences (i.e., 6, 10, and 13th) were held in integrated with other conferences. The 6th WMSE conference was held in integrated

with "4th Erosion and Sediment National Conference". The 10th WMSE conference was held under "Water Harvesting and Watershed Management Congress" that is also comprised the "1th National Conference on Qantas" and "3rd National Conference on Rainwater catchment system". In addition, the 13th WMSE conference was held with "The 3rd National Conference on Conservation of Natural Resources and Environment". Finally, it is also worthy to note that several international guests participated in some of the WMSE conferences (such as 4, 6, 9, and 13th conferences).

Number of papers published in WMSE conferences

Despite the author's many efforts, due to the lack of documentation or absence of appropriate archives, no information was found about the 1st to 3rd WMSE conferences. In the past 11 conferences (from 2008 to 2019), 2794 papers with 5029 authors have been presented at WMSE conference (Diagram 1). Minimum (95) and maximum (410) number of papers published in the WMSE conference were found for 2017 and 2019 that hold in the Malayer and Urmia universities, respectively. The number of papers published in the WMSE conference has a cyclic pattern during 14 study conferences. The number of papers published in WMSE conferences has increased one and a half times (i.e., 54%) in the seven years from 2008 to 2014. However, in 2016 and 2017, the number of papers dropped to 119 and 95, the decline of 71 and 77%, respectively (Diagram 1). The same situation was recorded for the author's contribution to the WMSE conferences (Diagram 1). Reasons for this decline probably consists of the statements of Esfandiarpour-Borujeni *et al*. [45]. According to Esfandiarpour-Borujeni *et al*. [43], the reasons may include the multiplicity of congress in Iran and sometimes their concurrence with WMSE conference, relatively high costs and lack of financial accountability for some students, some headers preferred the quality of papers versus quantity, higher score of journal papers than conference papers for scientific promotion of faculty members in the universities and research institutes of Iran, decline in the quality of conference papers, lack of a suitable future in Iran for graduated students of WM science which consequently declines in their motivation to participate in the WMSE conference. After that, the number of papers presented at 10th WMSE conference increased by 54% (Diagram 1).

According to the results, there was also a sharp increasing were occurred in the number of papers published in the WMSE conference in 2015 compared to previous years. The reason for this increase is attributed to its integration with two other conferences. In this year the WMSE conference was held under "Water Harvesting and Watershed Management Congress" that attracted much more participants and consequently more presentations. In addition, in the last two years, a significant increase was found in the number of papers published in the WMSE conference with a number of 319 and 359 papers, respectively for 2018 and 2019. The most important reason of such high contributions could be related to the national and political importance of WM issues and their highlighting by the supreme leader of Iran in the past two years and due to happening hazards such as flood and dust storms in the most parts of Iran and critical degradation of important domestic lakes, including Urmia Lake. So that, a total budget of €150 million of the National Development Fund of Iran (NDFI) has been earmarked to WM measures in the current year to end March 2020 [44].

The contribution of universities and research institutes in the WMSE conferences papers compilation during different years is shown in Diagram 2-a. From 2008 to 2019 universities have more contribution rather than research institutes. It could be concluded that in the whole period, the role of execution sector was lower than the research sector. The investigations also showed that respectively 52, and 43% of the Ph.D. and M.Sc. students were involved in the compilation of the papers during 11 WMSE conferences (Diagram 2-b). The role of enhancing volunteers for academic education at a time frame has a significant role. In recent decades, the policy of higher education has changed in Iran, probably to achieve new technologies for social progress and financial development [43, 45]. Therefore, there was a considerable increase in the number of WM students in the past decade. In overall, the contribution of males was significantly higher than females during all years of WMSE conference (Diagram 2-c).

Important issues discussed in WMSE conferences

As can be seen from Table 2, a range of different issues related to WM was discussed. Despite,

much research findings have been presented in such professional conferences, due to the lack of use of these results in the policy and execution sections and governance, low-impact successes have been achieved in the process of reducing dilemmas. A typical example of this failure was the explosion of severe dust storms in the several last years, especially in the western parts of Iran. Besides extensive floods, with a lot of human and financial losses throughout the country in recent years and the occurrence of successive droughts. However, using some terminologies and keywords such as crisis management, policies, laws, and governance to integrated WM is showing the positive trend of sound understanding the importance of WM in the human well-being and sustainable development of the country.

Table 1) An overview of the Iranian WMSE conferences from 1973 to 2019

WMSE Conference	Date	Location	Header	Scientific chair	Organizing chair	Main theme
1th	1973	University of Tehran	No data	No data	No data	Explaining the political and social concepts of the watersheds
2th	1977	Forests, Range and Watershed Management Organization of Iran (FRWMO)	No data	No data	No data	Acquaintance of foreign consultants with watersheds of Iran
3th	1990	Watershed Management Department of Zanjan Province	No data	No data	No data	Challenges of natural resources
4th	February 20, 2008	University of Tehran, Karaj City	Dr. Hasan Ahmadi	Dr. Ali Salajegheh	Dr. Ali Salajegheh	Management of watersheds
5th	April 22, 2009	Gorgan University of Agricultural Sciences and Natural Resources	Dr. Ramin Rahmani	Dr. Majid Ownegh	Dr. Vahedberdi Sheikh	Natural hazards sustainable management
6th*	April 28 and 29, 2010	Tarbiat Modares University, Noor City	Dr. Farhad Daneshjoo	Dr. Seyed Hamidreza Sadeghi	Dr. Hamidreza Moradi	Ecosystem balance
7th	April 27 and 28, 2011	University of Isfahan	Dr. Sayed Jamaleddin Khajeddin	Dr. Saeed Soltani Kopaei	Dr. Reza Jafari	Urban WM
8th	May 16 and 17, 2012	Lorestan University	Dr. Hasan Zamanian	Dr. Hossein Zeinivand	Dr. Nasser Tahmasebipour	Executive solutions of comprehensive WM
9th	October 30 and 31, 2013	Yazd University	Dr. Ali Talebi	Dr. Ali Talebi	Dr. Ali Talebi	WM in arid areas (floods and droughts)
10th*	February 18 and 19, 2015	University of Birjand	Dr. Sorena Sattari (Congress header); Dr. Tajbakhsh Fakhrabadi (Conference header)	Dr. Hadi Memarian	Dr. Sholeh Ghollasimood	Adaptive WM
11th	April 19 to 21, 2016	Yasouj University	Dr. Mahmoudreza Rahimi	Dr. Mohammad Sedghi Asl	Dr. Mohsen Armin	Participatory development in WM
12th	October 10 and 11, 2017	Malayer University	Dr. Behnoush Farokhzadeh	Dr. Behnaz Attaeian	Dr. Farhad Ghasemi Aghbash	WM and environmental crises
13th*	October 2 and 3, 2018	University of Mohaghegh Ardabili	Dr. Ardavan Ghorbani	Dr. Raoof Mostafazadeh	Dr. Mohammad Ahmadi	WM and conservation of common regional natural resources and environment
14th	July 16 and 17, 2019	Urmia University	Dr. Rahim HobbeNaghi	Dr. Hirad Abghari	Dr. Habib Nazarnejad	WM and Integrated management of water and soil resources

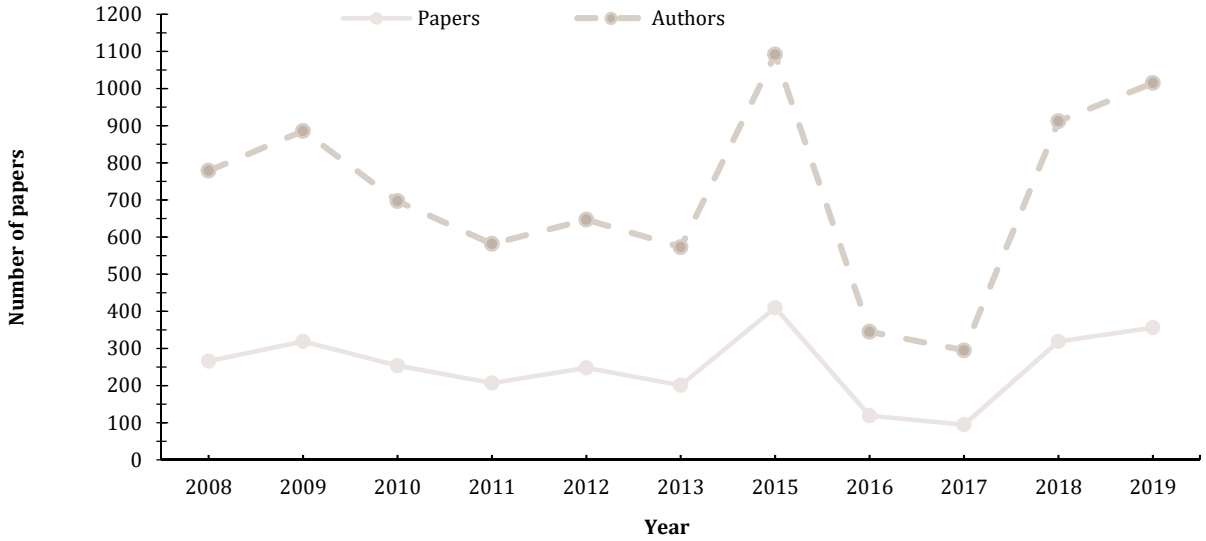

Diagram 1) The number of published papers and total authors contributed to the Iranian WMSE conferences over time from 2008 to 2019

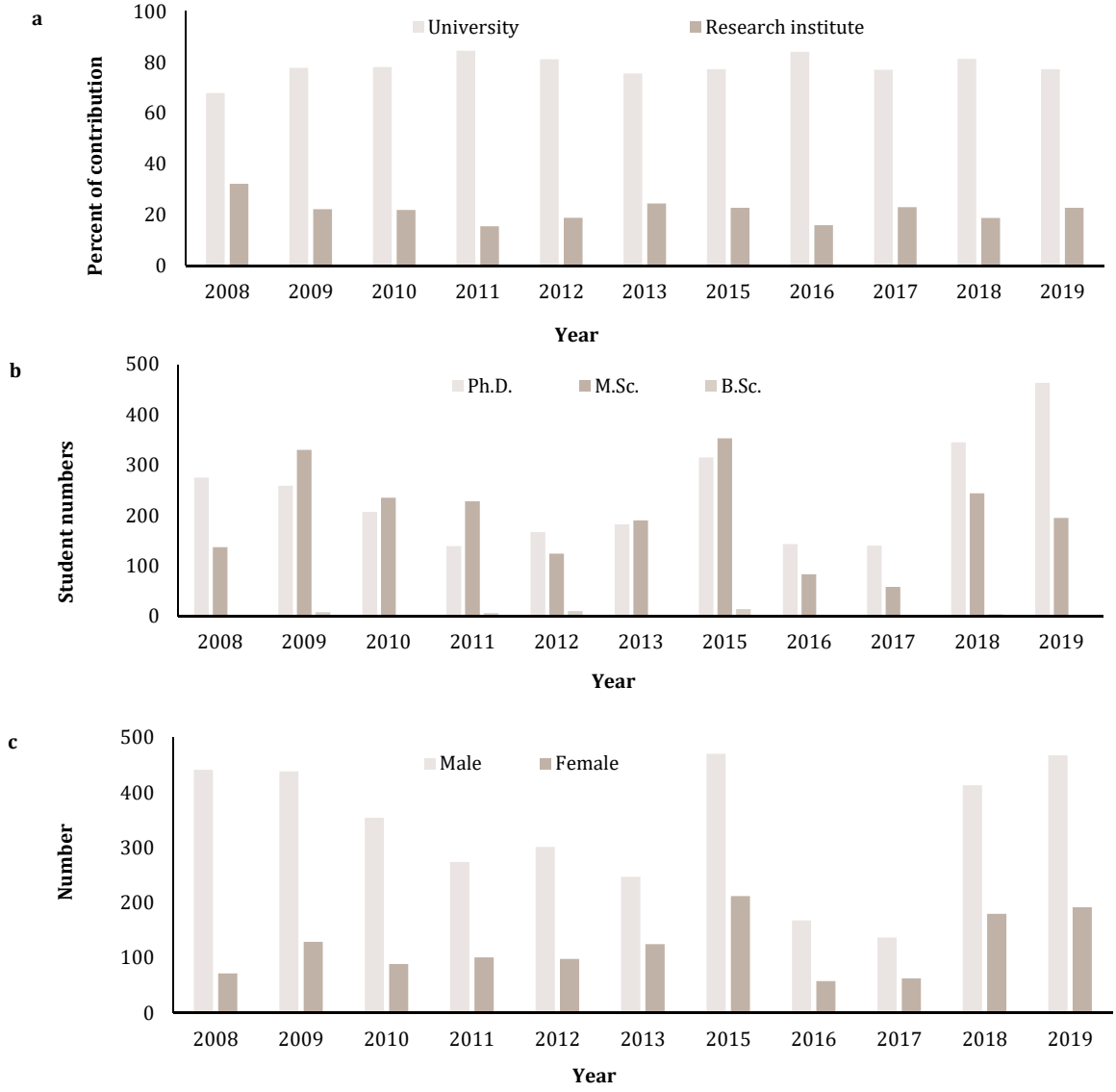

Diagram 2) The contribution of universities and research institutes (a), students at different scientific degrees (b), and males and females (c) in the Iranian WMSE conferences during different years

Table 2) Sub-theme of WMSE conferences from beginning to now

WMSE Conference	Important Issues Discussed in WMSE Conferences
1 to 3th	No Data
4th	WM and sustainable development; WM and land use planning; WM and the environment; WM and comprehensive management of natural resources; WM and water and soil resources; WM, people and rural development; Urban WM; WM and climate change; Mathematical and computer models; Modern methods (RS, GIS, etc.)
5th	WM, drought; WM, flood; WM, massive movements; WM, erosion and sediment; WM, climate change and land use; WM, water and soil resources health; Biological restoration of watersheds, channels and rivers; Holistic view on management of watersheds
6th*	WM and sustainable development; WM and environment (land use planning and biodiversity); WM and productivity of resources; WM and social and economic development; Soil erosion, sediment yield and watershed ecological equilibrium; Concept and process of sediment yield and routing; Concept and process of soil erosion; Soil erosion, sediment inside and outside effects and results
7th	Integrated and optimal management of water and land resources and land management in urban watersheds and economic and social issues; Natural disasters in urban watershed (climate change, drought, floods, dust storms, mass movements); New technologies: Biotechnology, nanotechnology, remote sensing and GIS in urban watershed; Risk and crisis management, reducing biological contaminations and optimal development of green spaces; Models in urban WM
8th	The role of legislation and policy in integrated WM; The role of strategic planning and land use planning in integrated WM; The role of comprehensive WM in sustainable land development; The role of stakeholders participation (urban, rural, nomadic, etc.) in integrated WM; The study of socio-economic and cultural issues in integrated WM; Role of science, research and new technologies in integrated WM; Obstacles and challenges for funding resources and management and execution organizations in realization of integrated management of watershed
9th	Capabilities and constraints of vegetation development; Climate change and its role in flood and drought phenomena; Low cost and best performing methods of reducing the effects of flood and drought phenomena in terms of economic and social values; Indigenous knowledge and technological techniques for reducing floods and droughts; The role of domestic and international laws and rights in flood and drought; Monitoring and evaluating of flood and drought management projects; The role of comprehensive WM and land use planning on flood and drought management; The role of anthropogenic factors on flood and drought
10th	Peoples participation in integrated planning and management of watersheds; Evaluation of traditional and modern systems of exploitation, legal and religious issues; Engineering (hydraulics, hydrology, hydrogeology); Environment, self-purification and water quality; The role of historical and cultural as a treasure of water; Nutrition methods for underground aquifers and revival of Qantas; Methods of maintenance, management and economics; Tourism of old and new aquatic structures (dam, Qat, etc.)
11th	The components of local communities' participation process in watersheds; Native knowledge of watershed inhabitants and conservation of watersheds resources; Laws and programs of country development and public participation in WM; Socio-economic assessment of WM projects; Sustainable development of watersheds; New technology in comprehensive WM
12th	Quantification and modeling of environmental crises; Monitoring and assessment of environmental crises; Management of natural crises
13th	National Mega Project on the Integrated WM; Watershed ecosystem services; Watershed health and sustainability; WM of border rivers; Tools and approaches of common of watershed resources management; National and international scales of integrated management of watershed resources; National and local experiences alternative livelihoods to improve the watershed socio-economy; Dynamic and restoration of rangeland and forest ecosystems; Approaches of assessment and control water, soil and weather resources pollution; Management and application of lignocellulose resources; Modern spatial technologies in natural resources and environment; Laws and legal issues of natural resources and environment conservation; Monitoring, prediction and modelling of natural resources and environmental challenges
14th	WM and crisis management of the Urmia Lake; Hydrological behaviors of inland water ecosystems; Interaction between natural and human factors in water and soil crises; Monitoring and assessing the performance of WM measures in reducing environmental crises; Technologies and tools for watershed changes forecasting; Policies, laws, plans and governance in the management of watersheds

History and achievements of Watershed Management Society of Iran

The Watershed Management Society of Iran (WMSI) [46] is one of the oldest scientific societies in Iran and was created in 1998. The society was located in the Watershed Management Deputy place, Ministry of Agriculture-Jahad, Tehran. Its first president was Prof. Mohammad Mahdavi who now is the emeritus of Faculty of Agriculture and Natural Resources, University of Tehran. The society started with 450 members and presently has nearly 2320 members (Male: 1798; Female: 522). These members were considered as people that only registered in the society webpage. As mentioned before, in its first phase, the WMSI was housed at the Ministry Of Agriculture-Jahad, Tehran. From 2002, the activity of this society has been done at the faculty of Natural Resources, University of Tehran. In 2007, the start of publication of the Iranian Journal of Watershed Management Science and Engineering [47] was done under consideration of this society. The WMSE conferences happen without interruption since 2008 with the corporation of WMSI. The first one (2008) had 513 authors that presented 266

papers. The last one (2019), in Urmia (West Azarbaijan Province), had 659 authors with 356 papers presented. The next WMSE conference was planned for October 27-29, 2020 in Sari, Mazandaran Province [48]. Beside the national WM conference, in its 21 years, the society also promoted and co-sponsored several other scientific congresses and conferences in national and regional levels related to WM such as 3rd National Conference on Hydrology of Iran, National Conferences on Rainwater Catchment Systems, AGROSYM 2018 and 2019, World Association of Soil and Water Conservation (WASWAC) conferences, National Conferences on Soil Conservation and Watershed Management, 2nd IAHS Panta Rhei International Conference on Water System Knowledge Innovation and Its Practices in Developing Countries. The society became more involved in national and international activities and hosted several workshops and scientific meetings, etc. In the last years, it is also increased the number of student meetings organized by universities. From the beginning time of WMSI activity, the Board of Directors has been changed, every two years. Under WMSI responsibility, three journals of Iranian Journal of Watershed Management Science and Engineering [49], Extension and Development of Watershed Management [50] and Iranian journal of Ecohydrology [51] respectively started from spring 2007, spring 2013, and summer 2014. The society received the rank a from Iran scientific associations commission amongst 15 scientific societies for successive six years (2013-2018).

The society publishes monthly newsletter from 2015 and also published some important books and domestic and international papers. The board of directors, composed of 11 members, is developing an agenda and strategic planning for the next years that reinforces that the society should aim to:

- Improving the national strategy on soil and water management according to FAO Agenda for the 21st century and preparing the required mechanisms
- Efforts toward promoting knowledge and awareness of the public, authorities, and decision-makers on WM and familiarizing them with the requirements of water and soil resource preservation
- Cooperation with public organizations concerning developing consultation on natural disasters such as flood, drought, landslide as well as supervising research and executive projects in these fields
- Participation and cooperation with international and national organizations in other countries in the implementation of resource restoration and reclamation projects
- Planning for international conferences holding
- Publication and dissemination of conference proceedings and research findings
- Providing educational services through organizing workshops, seminars, scientific lectures, and short-term courses
- Establishing branch offices at the provincial level and admission of new members aimed at the quantitative extension and development of the Society to the most remote areas across the country
- Developing expertise knowledge on issues concerning the fields of activity by the society and the dissemination of views and knowledge through the mass media
- Publishing a newsletter and a quarterly scientific journal in WM entitled "Iranian Journal of Watershed Management Science and Engineering", "Extension and Development of Watershed Management", and "Iranian Journal of Ecohydrology"
- Paying homage to and venerating the pioneers and activists in the field of soil, water and WM through mechanisms and means as deemed appropriate by the Board
- Publishing books and technical manual
- Up-to-date website
- Participation in natural resources and WM laws and regulation
- Organizing International, regional and national conferences

In addition, the society is organizing a wide range of activities and events to celebrate and call public attention to WM, in special on the national day of the WM and natural resources week, annually. WMSI has signed several memorandum of understanding forms with Czech Society of Soil Science, University of Perugia (Italy), World Association of Soil and Water Conservation and Montenegro University, etc. At present, the society is busy with the organization of the 15th WMSE conference to happen in 2019, for the first time in Sari.

Challenges for Iranian watershed management sciences research

It is appropriately documented that Iran is suffering from unprecedented problems,

including environmental and managerial, today. Unfortunately, both natural and human-induced environmental problems lead to critical watersheds degradation. For example, as stated by Madani *et al*. [52] the soil erosion, drying up water resources, land subsidence, degradation of water quality, desertification and dust storms (particularly in the southwest of Iran) are some of the challenges that the Iranian watersheds and watershed managers faced with.

On the other hand, according to the UN projection scenario, the population of Iran will increase to 107 million by 2050. Further population growth would inevitably reduce per capita freshwater availability, and lead to serious food security challenges [45, 53]. Therefore, the pressures on natural resources of the watersheds will be multiplied in the near future, undeniably. Moreover, Tables 3 to 5 summarized some important problems, challenges, and corresponding solutions related to WM of Iran. The recommendations could be used to improve watershed stability and the livelihood conditions of the watershed residents.

In general, it could be concluded that the current structure of the watershed governance system in Iran and the absence of a comprehensive understanding of the root causes of the problems leave a little hope of developing sustainable solutions to Iran unprecedented watershed problems.

Future of watershed management sciences in Iran

There are many studies concerning the increasing threat of watershed resources scarcity and their vulnerability at regional and national scales for Iran in the future. Iran is under different crises in regards to watersheds services. For example, Rezayan and Rezayan [1] reported the severe water crisis for Iran by 2050. Besides, precipitation and temperature anomalies (drought) respectively in some places of Iran indicate warming in future. So future WM will be faced with the worrying prospect, that if do not set the correct management and favorable domestic and international policies for the future. Therefore, it is essential to recognize the consequences of watershed services and resources management.

Decision-making in WM for future development is one of the most important circumstances where uncertainty plays an important role in the watershed scale. The decision-making is the basic reason underlying the tendency and the requirement for adopting different watershed resources scenarios [58-64]. Continuing challenges include comprehensive managing the degraded watersheds as well as taking into account potential future problems that mentioned for Iranian watersheds.

The primary impediment for mitigating the watershed degradation via WM strategies in Iran is the constraint to funding. Internationally, a lack of interaction between research institutes and the local people, policymakers, and politicians has been recognized as a problem in implementing advances in WM [54]. Anyhow, complex problems require integrated solutions. No single solution will "fix" watershed problems of the country. Madani *et al*. [27] noted that Iran requires a shift from the "nature control" paradigm to the "nature management" paradigm and reduced reliance on structural and technological solutions. To establish a local watershed governance system, a new political culture should be encouraged to accept local democratic participation. There are far many actors with varying and usually conflicting interests and so balancing the interests of all local stakeholders is a complicated process. Therefore, the new political culture should embrace participatory governance. We need a significantly enhanced understanding of the multi-dimensional nature of risk and its dynamic interactions with human, ecological, economic, and political systems [65].

As previously explained, a set of questions designed to obtain the necessary information required in this study. The questionnaires have been sent to 25 key actors (organizations, agencies, and institutions). Cronbach's alpha is the most widely used method for calculating the reliability of the questionnaire was obtained equal to 0.8 indicated the internal consistency of items and acceptable reliability of the questionnaire. The results of the questionnaire analysis were tabulated in Table 6. The results showed that the current state of the education, research, policy and execution sectors in WM was respectively good (76%), medium (32%), bad (48%), and medium (56%). Besides, they predicted the medium (40%), good (40%), medium (44%), and medium (48%) states for future of WM in education, research, policy, and execution sectors, respectively.

Table 3) Some of the important problems reported for Iranian watersheds

Main problems
Over- grazing; Desertification [54]
Population growth; Mechanization of plowing; Nationalization of rangelands and water resources; Decline of traditional management systems [1]
Over grazing; Conversion of rangeland to rain-fed areas; Poverty and insufficient yearly income; Conflicts; Shortcoming of current laws and administrative office; Lobby (local pressure groups); Fire; Cultivation in the wetland, grassland and stream border; Unsuitable road constriction; Improper mining; Illegal land leveling and changing of natural drainage system, using heavy machinery (bulldozers, etc.); Increase in rubbish (plastic bag and can); Dusts in spring season; Improper tillage practices (up to down the slope); Crop residual burning; Cultivation without rotation and fallow periods; Over application of chemical fertilizers, pesticide and herbicide; Conversion of rangeland to rain-fed croplands; Conversion of the wetland, grassland and border of stream, river and drainage to agricultural areas; Economic issues (mainly poverty and insufficient incomes); Shortcoming of current laws and official monitoring; Unsuitable road constriction [55]
Rapid population growth; Migration and urbanization; Inadequate water distribution infrastructure; Water quality degradation; Inefficient agriculture; The dream of self-sufficiency in food; Rising water demand; Cheap water and energy; Dams; Deep wells; Droughts; Floods; Climate change; Thirst for development and incomplete hydraulic mission; Sanctions and economic instability; Improper water governance structure; Environmental unawareness [52]

Table 4) Some of the important challenges reported for Iranian watersheds

Main challenges
Lack of proper planning and ecological assessment [54]
Contradicting national priorities (e.g., food self-sufficiency versus natural resources conservation); Uncoordinated interventions by sector governments; Focus on infrastructure; Top-down approaches; Lack of community participation [1]
Lack of political will; Government mistrust of citizens (and vice versa); Legal empowerment of people; Lack of awareness in government of the opportunities; Lack of adequate policies [56]
Rapid population growth and inappropriate spatial distribution of population; Inefficient agriculture sector; Mismanagement and thirst for development [52]
Multiplicity of decision centers; Lack of external organizational coordination; Lack of real participation of stakeholders in designing and implementation of projects and disregarding economic-social studies [57]

Table 5) Some of the potential solutions reported for Iranian watersheds

Main solutions
Integration between natural resources management programs; Planning for sustainability at the local level; Adoption of sustainable practices; Innovation in the use and management of water; Engaged stakeholders and institutions [1]
Fallow and rotation periods; Training and extension (Fire control in the forest and range (by penalty)); Orchard and tree planting; Seeding in the rangeland; Control of crops residual burning (by penalty or levy); Forage cultivation on the steep slops; Optimum usage of chemical fertilizers and pesticides; Forest protection by government intervention; Strip cropping at the hill slope; Controlling the improper tillage by penalty or levy; Technical methods (Earth dam, check dam, terracing, etc.); Overgrazing control with participation of stakeholders; Preservation of rangeland with government intervention; Monitoring and effective supervision of non-agricultural activities such as mining and road construction; Enactment of new laws and amending of current laws; Soil conservation measures with farmers' participation; Introducing new technology for sustainable agricultural activities; Preservation of critical areas [55]
Revisiting the new population growth policy, paying careful attention to the spatial distribution of population and limiting urbanization growth rate; Modernizing agriculture and empowering farmers and rural communities; Revising the crop pattern across the country with respect to national food security priorities as well as regional resource availability and economic efficiency conditions; Increasing the water and energy prices together with technological improvements to prevent socio-economic pressure on rural and farmer communities; Promoting and developing regional farming cooperatives and water management institutions; Implementing water markets and setting up environmental water accounts; Shifting from reactive to proactive management of the water sector; Optimizing the distribution of water management efforts to solve the existing water problems and to prevent emerging ones; Reorganizing the current water governance structure and empowering the Department of Environment Raising environmental awareness and educating the public; Re-establishing the balance between water supply and demand through developing additional sources of water supply and implementing aggressive water demand reduction plans [52]
Demand management [58]
Implementation of integrated management [57]

Table 6) Results of questionnaire analysis

No.	Interest question	Very good	Good	Medium	Bad	Very bad	Maximum percent (evaluation)
1	How is the status of watershed management in the education sector?.	1	19*	4	1	0	76 (Good)
2	How will the future of watershed management in the education sector go?.	2	9	10*	4	0	40 (Medium)
3	How is the status of watershed management in the research sector?.	4	7	8*	5	1	32 (Medium)
4	How will the future of watershed management in the research sector go?.	3	10*	6	5	1	40 (Good)
5	How is the status of watershed management in the policy sector?.	0	3	8	12*	2	48 (Bad)
6	How will the future of watershed management in the policy sector go?.	0	8	11*	5	1	44 (Medium)
7	How is the status of watershed management in the execution sector?.	0	4	14*	4	3	56 (Medium)
8	How will the future of watershed management in the execution sector go?.	1	6	12*	4	2	48 (Medium)
9	In general, how do you anticipate the future of watershed management in the country?.	0	8	12*	4	1	48 (Medium)
10	What strategies do you recommend in each of the above areas to achieve the optimal watershed management state in the country?.	-	-	-	-	-	20 response received and then analyzed.

* shows the most percentage of contributions.

The following recommendations and strategies were presented by target people in the questionnaires:

1- Education and research should be integrated with the execution to make the problems priorities one of the priorities of the education and research sectors. Because the education and research sectors have been isolated and no interactions have been made between education, execution, and research.

2- Comprehensive WM with the participation of all executive organizations within the watershed is essential.

3- Creating a common need for education, research, and execution for working together, and thinking on prioritization the issues, challenges, and solutions for WM in all three mentioned sectors

4- Legislating comprehensive WM as the main development strategy of the country is suggested.

5- The presence of the WMSI as the scientific body in decision and policymaking is a necessity and requisite.

6- Increasing the inter-organizational relationship between different organizations, and between education, research, policy, execution and even market sectors are encouraged.

7- Organizational cohesion, public participation, attracting credit from different sources, and providing greater quantitative and qualitative effectiveness are emphasized.

8- Appreciating WM and the use of young students, experts, and graduated students, and the necessity of comprehensive WM in projects implementation need to taking account.

9- Implementation of a comprehensive applied research plan across all sectors of the country development to determine the impact factor of WM in improving conditions of natural resources, and in controlling floods is also confirmed.

10- Change the approach of expert managers and policymakers, drafting and approval of the Comprehensive Law on Management of Country Watersheds, and providing legal and systematic rules to control the development activities of other ministries of the country is highly important.

11- Allocation of credits on a watershed scale not in a provincial or county level is crucial.

12- WM is an important part of natural resources, so its independent governance from other organization is vital, because of current governing non-holistic view led to its debate and neglecting in the policy-making.

13- Sufficient financing needed to run a good execution.

14- The most important problem in the country is the separated of research and execution sectors, which this gap needs to be filled without any prejudice. Additionally, because of the lack of comprehensive view and management, organizational cohesion, and structural reinforcement are emphasized. The WM situation in Iran could be improved in the future if education, research, and execution sections will be in the same direction, and practical outcomes of such scientific conferences would be used.

15- It is important for managers and policymakers to better understand the importance and necessity of the issue, and to establish direct and effective communication between policymakers, executives, and universities.

16- The organizational state of WM needs to return to the period of Ministry of Agriculture-Jihad as an independent deputy. Separation of WM from FRWMO, and its integration with Water Department, Ministry of Energy and Department of Environment that leading to establish the "Ministry of Natural Resources and Watershed Management" is suggested.

17- The state of education sector is now appropriate. The research sector should receive more grants as much as possible. For the policy sector, it needs a maximum presence in the social networks to demonstrate the importance of WM issues. Policymaking is a prerequisite of execution sector.

18- The scientific results must be applied in the field of policy sector. As long as researchers go their own way, policymakers take a distinct path without considering the results of their research. However, this is true for most the natural resource fields and not only for WM.

19- Development of new rules and laws, and pay more attention to the systematical implementation of plans of WM, soil conservation, and natural resources at the national level is proposed. Furthermore, in the viewpoint of the execution sector, and determining their true position in national land use planning projects is important.

20- In the viewpoint of the research sector the reviewing practical solutions and explaining

services descriptions, and investigating the problems of execution sector is proposed. Finally, in the viewpoint of the execution sector, the formulation of a comprehensive law on natural resources, and the implementation of management strategies are recommended.

Conclusion

In the present study, the Iranian Conference on Watershed Management Sciences and Engineering (WMSE) from 1973 to 2019 was reviewed. The history and some selected highlights were described. WM issues have been concerned over the past decades in many countries, including Iran. Based on all the insights and results, a more holistic and participatory approach to WM of Iran would be developed. Since most of the changes in watershed components of climatic, hydrologic, and anthropogenic were not uniformly distributed across Iran, the adaptation response should be different for different parts of the country. Developing a new generation of WM programs is strongly recommended to be more effective at reducing environmental degradation of the watersheds and will have the potential to make a very significant contribution to sustainable development. Also, the increased use of green infrastructure and resilient management practices to enhance the resilience of the watershed system is proposed. The results and analysis of the present study, can be a precise roadmap for future WMSE conferences and provide a strategy for the correct management and rational facing a watershed resources crisis for the coming years.

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