Hindawi
Scientific Programming
Volume 2022, Article ID 4016217, 7 pages
https://doi.org/10.1155/2022/4016217

Research Article

Water-Saving Benefit Model Analysis of Plain Reservoirs in Arid Areas Based on Nonlinear Data Prediction under Floating Ball Cover

Haitao Wang,[1,2] Xinjun Yan ,[1,2] Kebin Shi,[1,2] and Siyuan Xu[1,2]

[1]*College of Hydraulic and Civil Engineering, Xinjiang Agricultural University, Urumqi 830052, China*
[2]*Xinjiang Key Laboratory of Hydraulic Engineering Security and Water Disasters Prevention, Urumqi 830052, China*

Correspondence should be addressed to Xinjun Yan; 164304214@stu.cuz.edu.cn

Received 2 July 2022; Revised 18 July 2022; Accepted 23 July 2022; Published 19 August 2022

Academic Editor: Wang Jianxing

In order to reduce the ineffective evaporation of plain reservoirs in arid areas, strengthen the effective utilization of water resources, and explore effective water-saving benefit models. *Research methods*: Field tests were carried out with antievaporation floating balls with different coverage rates, and the water-saving rate and economic benefits under floating ball coverage were analyzed. By analyzing the frequency of different wind speeds, daily evaporation under different coverage rates, monthly evaporation inhibition rates under different coverage rates, and the cost of materials used were analyzed. The results showed that (1) during the test period, the total evaporation from the water surface of different cover groups was 149.5 mm, 122.2 mm, 100.1 mm, 81.1 mm, and 63.1 mm, respectively, and the evaporation inhibition rates of different cover groups were 18.4%, 30.8%, 43.4%, and 58.6%, respectively. (2) Comprehensive consideration of the preliminary input and output ratio of the latter determine when the float coverage rate of 50% is the optimal coverage rate, the annual water savings of 5421.86 m^3, the annual increase in production value of 87,700 yuan, and the float in the reservoir site operation for 5 years to reach the recovery period and start to profit. (3) Based on the analysis of the economic indicators of laying floating balls in a large area of the reservoir and the calculation of the sales income and total investment, the results show that the total investment is a sensitive factor, and the project has a strong risk resistance ability. Therefore, the floating ball covering method to inhibit the ineffective evaporation of water surfaces is practical and feasible in terms of reservoir water-saving and economic benefits.

1. Introduction

As one of the most important natural resources, water resources are indispensable when human beings and other organisms are interdependent [1–3]. The total freshwater resources on land account for only 2.53% of the total water bodies on Earth, and most of them are solid glaciers mainly distributed in the north and south polar regions. In addition, in semiarid and arid areas, water resources are an important limiting factor for the local realization of the high-quality development of the "economic ecological" community and the lifeline of Northwest China [4]. Especially in Xinjiang, China, due to the unique climatic conditions, the annual average precipitation in Xinjiang is only about 150 mm, but the annual evaporation is as high as 2000–3000 mm, causing serious water loss to the local plain reservoirs and ponds [5]. Therefore, the evaporation prevention of plain reservoirs in arid areas has very important practical significance. In the arid areas of inland China, the annual precipitation is too low, and the evaporation is too large. Therefore, alleviating the consumption of water resources in arid areas and reducing evaporation are the key issues. The research shows that the physical covering method is ideal for evaporation prevention and water-saving technology for plain reservoirs in arid areas. Scholars at home and abroad have conducted a lot of research on the physical coverage method to suppress the ineffective evaporation on the water surface. In 2013, Benzaghta [6] and others studied the water surface evaporation inhibition rate in the humid climate area covered by Mengkuang mat, plywood, and galvanized tile plate. The test showed that the evaporation inhibition rates were 40%, 33%, and 26%, respectively. After the test, the water under the coverage was tested and found that there was no adverse change in the water quality; in 2015, California laid nearly 96 million black polyethylene floating balls in the reservoir to reduce evaporation [7]; in 2016, Licun Li [8, 9] and others used PVC foam boards with different coverage areas and thicknesses as covering materials to calculate the water surface evaporation inhibition rate under their coverage; in 2017, Silva [10] and others used floating discs to suppress the evaporation of the water surface of the solar gradient pool; in 2018, Hou et al. [11] conducted an experimental study on different parameters (coverage, diameter, and freedom coefficient) that affect the floating ball evaporation inhibition rate. The results show that the coverage has the greatest impact on the floating ball evaporation inhibition rate, followed by freedom coefficient and floating ball diameter; in 2020, Lizhen et al. [12] compared the magnetic floating plate with the nonmagnetic floating plate with a coverage area of 25%, 50%, and 75%, respectively, and concluded that the evaporation inhibition rate increased by 5.5%, 3.5%, and 1.8%, respectively; in 2020, Shi et al. [13] and others compared the evaporation inhibition rate of floating balls without arrangement under the same coverage area. The results showed that the effect of floating box fence combined with floating balls was better than that of single floating balls; in 2020, Kewu Han [14] and others studied the efficiency of reducing water surface evaporation under PE floating ball coverage.

Previous studies have analyzed the evaporation inhibition effect of different covering materials. The larger the coverage area, the higher the water-saving rate. However, the most important economic benefits in the application of physical evaporation prevention technology have not been analyzed and calculated. Through experiments, the water-saving rate of the evaporator under different coverage of floating balls is analyzed and studied, the most appropriate coverage is determined, and its economic benefits are evaluated so as to provide a reference for physical evaporation prevention technology.

2. Materials and Methods

2.1. Overview of the Study Area. The test site is located in shengjinkou reservoir in Shengjin Township, Turpan City, Xinjiang Uygur Autonomous Region. It is surrounded by mountains, Bogda mountain in the West and North, Kumtag hill in the East, and Queletag mountain in the South. Its unique terrain forms a warm temperate arid desert climate, which is characterized by dryness, windiness, and large temperature difference [15]. The annual average temperature is 15.1°C, the maximum temperature is 49.6°C, and the minimum temperature is -29.2°C. The annual average precipitation is 16.2 mm, and the average evaporation is 2845 mm. The annual average wind speed is 1.1 m/s, and the maximum wind speed is 25 m/s.

2.2. Test Materials. According to the previous research results [16], the homogeneous polyethylene ball with a diameter of 100 mm is used as the antievaporation material. The natural arc structure of the sphere reduces the contact area between the sphere and the object in the heavy wind and waves, reduces the wear of its own materials, and enhances the durability of the materials. A large area of water is easy to form waves. The spherical surface will be wetted when the floating ball moves up and down with the waves, and most of the water on the spherical surface will flow back into the water along the floating ball. Only a small part of the water will be adsorbed on the surface of the floating ball, and the water adsorbed on the surface of the floating ball will be evaporated quickly. The evaporated side wall of the floating ball can still inhibit the evaporation of the water surface [17].

2.3. Test Principle. The main factors affecting water surface evaporation are temperature, wind speed, relative humidity, water vapor pressure, and so on. The temperature rise of the water body absorbing heat will accelerate the movement speed of water molecules, thus overflowing into the air. The increase in wind speed will accelerate the disturbance rate of the surface air, and the water vapor will quickly diffuse to the outside space. The water vapor in the atmosphere is always in an unsaturated state. Therefore, the accelerated migration of water molecules will also accelerate evaporation. The black floating ball can effectively block a large amount of solar radiation and reduce the pressure difference on the water surface so as to effectively prevent evaporation.

2.4. Test Layout. Five circular evaporators with a diameter of 1.2 m and a height of 0.8 m are set on the dam crest of the reservoir, and the floating ball coverage areas are 0%, 25%, 50%, 75%, and 91%, respectively. A small evaporating dish is placed near the evaporator to monitor the on-site evaporation of the reservoir. Due to the different evaporation intensities of the water surface in each evaporator, the water volume in the evaporator will decrease in varying degrees. In order to accurately reflect the evaporation of the water surface, the water in each evaporator will be added to the same height after recording the data at 20 : 00 every day. The water level change is observed by scm-60 water level probe, and the observation accuracy is 0.01 mm. At the same time, automatic weather stations are used to monitor wind speed, atmospheric pressure, humidity, temperature, and other data.

As shown in Figure 1, the layout of the field equipment of the evaporator is shown, and the detection facilities are set according to the field conditions and experimental needs.

3. Results and Analysis

3.1. Wind Speed Analysis. The portable meteorological station is used to observe the meteorological data at the test site, collect the wind speed data during the test period, and make statistics on the days and frequencies of different wind speeds, as shown in Table 1. During the test period, the wind level is 0–1, and the wind speed is 0–1.5 m/s on most days,

Figure 1: Site layout plan.

Table 1: Days and frequencies of different wind speeds.

Serial number	Wind speed m/s	Wind level	Days d	Frequency %
1	0–1.5	0–1	7	3.9
2	1.6–3.3	2	133	72
3	3.4–5.4	3	37	20.2
4	5.5–7.9	4	2	1.1
5	>8.0	>5	5	2.8
Total			185	100

accounting for 3.9% of the total test period; when the wind speed is 1.6–3.3 m/s, the proportion reaches 72% in the total test period; when the wind speed is 3.4–5.4 m/s, the proportion reaches 20.2% in the total test period; when the wind speed is 5.5–7.9 m/s, it accounts for 1.1% of the total test period. During the test period, wind speed greater than 8 m/s will occur for a short time, accounting for only 2.8% of the total days.

As shown in Table 1, according to the statistics of the number of days, wind speed, and frequency of wind speed above levels 0–8, it can be seen that the frequency and number of days of wind speed at level 2 are more.

3.2. Analysis of Evaporation Capacity and Evaporation Inhibition Rate

3.2.1. Evaporation Capacity Analysis. The test period is from March to August 2021, of which May to August is the high evaporation period of the year. The evaporation capacity of the evaporator under different coverage rates during the test period is counted. As shown in the following figure, the evaporation in the test period increases day by day with the change of time. From the 20th day, the evaporation gradually increases with the increase of temperature, reaches the peak value in the test period, and gradually decreases around the 90th day. The coverage rate ranges from 0% to 91%, and the maximum evaporation per day is 2.3 mm, 1.8 mm, 1.7 mm, 1.3 mm, and 1.2 mm, respectively. Compared with the evaporator without coverage, the evaporation is reduced by 21.7%, 26.1%, 43.5%, and 47.8%, respectively.

As shown in Figure 2, the evaporation that began on the 20th day gradually increased with the increase of temperature and began to decline after the 90th day.

Based on the above data, the change in total evaporation can be obtained from Figure 3. During the test period, the

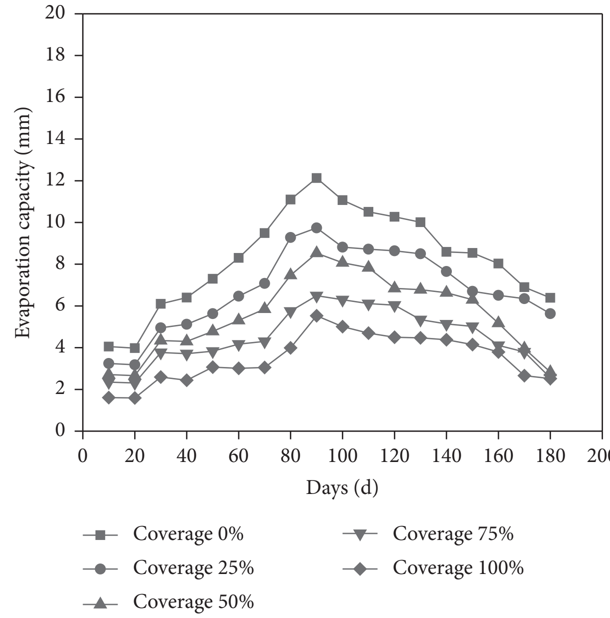

Figure 2: Daily evaporation at different coverage rates.

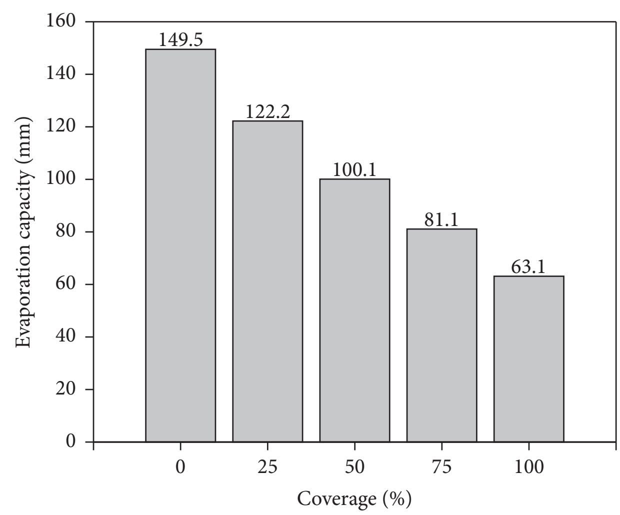

Figure 3: Total evaporation during the test period.

total evaporation from 0% to 100% coverage was 149.5 mm, 122.2 mm, 100.1 mm, 81.1 mm, and 63.1 mm, respectively. The evaporation decreased with the increase in coverage, and the evaporation decreased by 18.3%, 33%, 45.8%, and 57.8%, respectively, compared with the evaporator without coverage.

3.2.2. Analysis of the Evaporation Inhibition Rate. The water surface evaporation inhibition rate is an important index for watersaving in reservoirs in arid areas. See formula (1) for the calculation method as follows:

$$\alpha = \frac{E_0 - E}{E_0} \times 100\%, \qquad (1)$$

where $x3b1$; is the evaporation inhibition rate, %; E is the evaporation capacity of the evaporator under the floating ball cover, mm; E_0 is the evaporation capacity of the uncovered floating ball evaporator, mm. It is calculated that the average evaporation inhibition rate of 25%–91% coverage during the test period is 18.4%, 30.8%, 43.4%, and 58.6%, respectively, and the evaporation inhibition rate of the coverage area increases by 40.2% from 25% to 91%, which shows that the evaporation inhibition rate increases with the increase of the coverage area and vice versa.

As shown in Table 2, the evaporation inhibition rate increases with the increase of the coverage area. The smaller the coverage area, the smaller the inhibition rate.

Table 2: Monthly evaporation inhibition rate of different coverage areas.

Month	Evaporation inhibition rate %				
	0%	25%	50%	75%	91%
3	–	20.0	31.3	40.0	59.1
4	–	22.1	34.1	45.2	60.6
5	–	16.2	27.8	45.1	60.9
6	–	17.3	30.3	47.2	55.0
7	–	21.8	36.6	51.6	64.2
8	–	13.2	24.8	31.0	51.7
Average	–	18.4	30.8	43.4	58.6

3.3. Economic Benefit Evaluation and Analysis. In the popularization and application of floating balls, the most important evaluation index is the economic benefit generated by watersaving, so on this basis, it is analyzed in combination with the field reservoir. The selected case study area is the test site of this study. The Shengjinkou reservoir in Shengjin Township, Gaochang District, Turpan city, has an area of 5775 m^2, and the average annual evaporation for many years is 2845 mm. The polyethylene floating ball used in this test is selected as the paving material, and the unit price of this material is 150 yuan/m^2. Taking the agricultural water in this area as an example, the main local crop is grapes, the land volume per mu is 1500 kg, and the market price is 6.65 yuan/kg. According to the calculation, the material cost price and water-saving benefit are shown in the following table, and the cost calculation formula of the floating ball material is as follows:

$$P_T = S \times T, \tag{2}$$

where P_T is the total price of covering materials, yuan; S is the total area of covered water surface, m^2; P is the unit price of covering material 1 m^2, yuan.

Calculate the annual water saving of the antievaporation covering material by the following equation:

$$Q = \alpha \times E \times S, \tag{3}$$

where Q is the annual water saving under material coverage, m^2; α is the evaporation inhibition rate under floating ball coverage, %; E is the annual evaporation of the test area, mm; S is the water surface area of the test area, m^2.

As shown in Table 3, it is the calculation of water saving and material cost under different coverage rates of floating balls. When the floating ball coverage rate is 25%, the laying area of the water surface is 1443.75 m^2, the material cost is 216600 yuan, and the annual water saving is 3006.67 m^3; when the floating ball coverage is 50%, the laying area of the water surface is 2887.5 m^2, the material cost is 433100 yuan, and the annual water saving is 5421.86 m^3; when the floating ball coverage is 75%, the laying area of the water surface is 4331.25 m^2, the material cost is 649700 yuan, and the annual water saving is 7524.88 m^3; when the floating ball coverage is 91%, the laying area of the water surface is 5255.25 m^2, the material cost is 788300 yuan, and the annual water saving is 9496.47 m^3.

As shown in Table 4, according to the records of the Turpan water pipe station, the average planting area of grape land per household is 13.22 mu. In combination with the output and sales price of grapes per mu, after deducting expenses such as construction cost, material cost, and labor cost, the annual sales volume is the net profit of 91700 yuan.

As shown in Table 5, it is the economic benefit analysis before and after water saving of the reservoir. The total income from planting grapes before laying floating balls is 91700 yuan. After the floating ball is laid, according to the agricultural irrigation water quota of 690 m^3/mu in Turpan, the output increase values of the reservoir under different floating ball coverage rates can be calculated as 30200 yuan, 54500 yuan, 75600 yuan, and 95400 yuan, respectively.

As shown in Table 6, the normal service life of floating balls is set to be 10 years, and the recovery life and income of floating balls with different coverage rates are shown in the table above. Combined with Table 5, the total income of different coverage rates after water saving is calculated. The output increase value of water conveyance irrigation needs to be multiplied by the project benefit sharing coefficient on the basis of the total income. By consulting relevant literature [18, 19], the coefficient is 0.6, and the profits generated by water-saving irrigation are 73100 yuan, 87700 yuan, 100400 yuan, and 112300 yuan, respectively. The recovery period of floating balls with different coverage rates is 3–7 years. Therefore, considering the early input-output ratio, when the coverage rate is 50%, it is the optimal coverage rate, and the output increase value is 87700 yuan.

To sum up, laying antievaporation floating balls in the reservoir can bring good economic benefits. At present, floating balls are only laid in small reservoirs. If antievaporation floating balls are laid in medium and large reservoirs, the water saved by the reservoir every year will be converted into economic benefits.

3.4. Sensitivity Analysis. The construction period of the floating ball on the reservoir is set as one year, and the normal service life is 10 years. Sensitivity analysis is conducted on the sales revenue and total investment. The benchmark discount rate is taken as 8%, in which the total investment includes the floating ball material cost, grape planting labor cost, garden construction cost, and material cost. The sales revenue is the total income after water-saving irrigation and yield increase. The cash flow of the basic scheme is shown in the table as follows:

As shown in Table 7, according to the calculation, the net present value NPV = 32800 yuan >0, and the internal rate of

Table 3: Material cost analysis.

Floating ball coverage %	Unit price yuan/ m^2	Coverage area m^2	Total price ten thousand yuan	Water saving rate %	Water saving amount m^2
25	150	5775 × 25%	21.66	18.3	3006.67
50	150	5775 × 50%	43.31	33.0	5421.86
75	150	5775 × 75%	64.97	45.8	7524.88
91	150	5775 × 91%	78.83	57.8	9496.47

Table 4: Economic benefits' analysis.

Cultivation mode	Park construction cost	Material cost yuan/ mu	Labor cost yuan/mu	Total cost yuan/mu	Yield Kg/ Mu	Unit price yuan/kg	Planting area mu	Net profit ten thousand yuan
Open field cultivation	498.62	1366.83	1174.78	3040.23	1500	6.65	13.22	9.17

Table 5: Calculation of revenue-raising benefits.

Floating ball coverage (%)	Project	Irrigation area mu	Total revenue ten thousand yuan	Total yield increase ten thousand yuan
	Before water-saving	13.22	9.17	
25	After water-saving	17.58	12.19	3.02
50	After water-saving	21.08	14.62	5.45
75	After water-saving	24.12	16.73	7.56
91	After water-saving	26.98	18.71	9.54

Table 6: Float payback period and revenue calculation.

Project	Floating ball coverage %			
	25%	50%	75%	91%
Payback period year	3	5	7	7
Income calculation ten thousand yuan	21.14	27.25	22.68	28.62

Table 7: Basic programme cash flows.

Particular year	0	1	2	3	4	5	6–10
Sales revenue ten thousand yuan	0	8.77	8.77	8.77	8.77	8.77	8.77
Total investment ten thousand yuan	43.61	3.74	3.12	2.44	1.71	0.92	0.26

Table 8: Table of sensitivity factors and critical point analysis.

Uncertainties	Rate of change %	Internal rate of return %	Sensitivity coefficient	Critical point %	Critical value
Basic scheme		10.07			
Sales revenue	+20	17.47	3.67	−19.94	7.02
	+10	12.62	2.53		
	−10	7.41	2.64		
Total investment	+10	7.65	9.27	6.66	12.25
	+5	14.73	−2.40		
	−10	12.89	−2.89		
	−20	16.28	−3.09		

return IRR = 10.07% > 8%. Since NPV is greater than zero, and the internal rate of return is greater than the benchmark discount rate, this scheme is economically reasonable. Carry out uncertainty analysis on the project, select sales revenue and total investment as uncertainty factors, and calculate the corresponding internal rate of return, respectively, as shown in the following table.

As shown in Table 8, the absolute value of the sensitivity coefficient of the total investment is large, and the absolute value of the percentage of the critical point is small, so the total investment is a sensitive factor. It can be seen from the critical value that when the sales revenue drops to 70200 yuan, the internal rate of return of the project can still be guaranteed to be 8%. At the same time, when the total investment becomes 122500 yuan per year, the internal rate of return of the project can still be guaranteed to be 8%. Therefore, the overall sensitivity of the project is not strong. On the whole, the project has a strong ability to resist risks. According to the above research, it can be found that laying floating balls on the water surface can save water resources and bring considerable economic value to a certain extent. Therefore, the water-saving technology of plain reservoirs in arid areas covered by floating balls is feasible in both water saving and economic aspects.

4. Conclusion

In recent decades, materials and technologies for physical evaporation prevention have been constantly optimized and updated. EPS lightweight concrete slabs, color steel sandwich panels, benzene board composite partition boards [20–22], and plastic hollow slabs [16] in the early stage, as well as subsequent PVC floating plates [23], magnetic PVC floating plates [12], PE floating balls, and so on have good evaporation prevention effects. At the same time, the research on water surface antievaporation technology is also deepening. Therefore, on the basis of previous studies, the following conclusions are drawn through field tests:

(1) In the high evaporation period of the year, the evaporation capacity of the evaporators with floating ball coverages of 0%, 20%, 50%, 75%, and 91% were counted, respectively. With the increase in coverage, the water-saving rates were 18.3%, 33%, 45.8%, and 57.8%, respectively.

(2) Analyze the water-saving and economic benefits under the floating ball coverage and comprehensively consider the early input-output ratio, and when the coverage rate is 50%, it is the optimal coverage rate, the annual water-saving is 5421.86 m^3, and the output increase value is 87700 yuan. The recovery profit can be realized after the floating ball is operated on the reservoir site for 3–7 years.

(3) The economic sensitivity analysis is carried out for the large-area floating ball laying in the reservoir. The sales revenue and the total investment of the project are selected as the uncertainty factors for sensitivity analysis. After calculation, the total investment of the project is determined as the sensitivity factor, and the overall risk resistance ability of the project is strong.

This paper finds that the application of floating ball coverage in small reservoirs has practical significance for saving water resources and improving utilization efficiency and has reference significance for further study of water-saving resources in medium and large reservoirs. To sum up, the technology of floating ball covering to inhibit water surface evaporation can effectively improve the utilization rate of water resources and bring good economic benefits. It has important practical significance and promotion value. It is moving forward with the goal of large-scale promotion on the water surface of the reservoir. The floating ball coverage experiment in arid areas also provides reference basis and data support for the benefits of water resources and conservation technologies in other regions and effectively improves the utilization rate of water resources and technical advantages of our country.

Data Availability

The data underlying the results presented in the study are available within the manuscript.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

All authors have seen the manuscript and approved for submission to your journal. The authors confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

Acknowledgments

This work was supported by the National Natural Science Foundation of China (51968071), Research Project of Xinjiang Key Laboratory of Hydraulic Engineering Safety and Water Disaster Prevention (zdsys-yjs-2021-04), and Research Project on Key Disciplines of Water Conservancy Engineering in Autonomous Region (slxk2019-04).

References

[1] Z. Al-Shalalfeh, F. Napier, and E. Scandrett, "Water nakba in Palestine: sustainable development goal 6 versus Israeli hydro-hegemony," *Local Environment*, vol. 23, no. 1, pp. 117–124, 2018.

[2] H. Haider, P. Singh, W. Ali, S. Tesfamariam, and R Sadiq, "Sustainability evaluation of surface water quality management options in developing countries: multicriteria analysis using fuzzy UTASTAR method," *Water Resources Management*, vol. 29, no. 8, pp. 2987–3013, 2015.

[3] L. Zhang, H. sun, Y. Su, and H. Zhao, "Water resources utilization efficiency and its influencing factors in arid areas of Northwest China," *Journal of Ecology and Rural Environment*, vol. 33, no. 11, pp. 961–967, 2017.

[4] Q. Shang and K. Yin, "MI Wenbao Evaluation of water resources utilization in Qinghai Province Based on water footprint theory," *Resources and Environment in Arid Areas*, vol. 34, no. 05, pp. 70–77, 2020.

[5] K. Han, B. Shi, and X. Yan, "Analysis on evaporation prevention and water saving efficiency of plain reservoirs in arid areas under PE floating ball coverage," *Journal of Applied Basic and Engineering Sciences*, vol. 28, no. 02, pp. 376–385, 2020.

[6] M. A. Benzaghta and T. A. Mohammed, "Use of palm fronds as shaded cover for evaporation reduction to improve water storage efficiency," *Engineering Sciences*, vol. 25, no. 12, pp. 55–58, 2013.

[7] B. Chen, "New measures for drought relief of Los Angeles reservoir," *Daily mail*, vol. 8, 2015.

[8] C. Li, K. Shi, J. Y. Xin, and L. J. Cui, "Analysis on evaporation prevention and water saving efficiency of plain reservoirs in arid areas covered by floating plates," *Journal of water resources and water engineering*, vol. 27, no. 03, pp. 73–76, 2016.
[9] C. Li and X. Yan, "Shi Kebin Analysis on water-saving efficiency of plain reservoirs in arid areas covered by floating plates of different thickness," *J] Hydropower Energy Science*, vol. 34, no. 01, pp. 32–34, 2016.
[10] C. Silva, D. González, and F. Suárez, "An experimental and numerical study of evaporation reduction in a salt-gradient solar pond using floating discs," *Solar Energy*, vol. 142, no. 04, pp. 204–214, 2017.
[11] Z. Hou and L. Yanxinjun, "Experimental study on the sensitivity of floating ball parameters to the effect of inhibiting water surface evaporation," *Hydropower energy science*, vol. 36, no. 09, pp. 27–29+33, 2018.
[12] Y. Lizhen, X. Yan, and K. Han, "Analysis on water saving efficiency of plain reservoir in arid area covered by magnetic floating plate," *People's Yangtze River*, vol. 51, no. 03, pp. 179–184, 2020.
[13] X. Shi, K. Shi, and K. Han, "Analysis on evaporation prevention and water saving efficiency of PE floating ball covering in floating tank fence of plain reservoir in arid area," *Hydropower Energy Science*, vol. 38, no. 03, pp. 9–12, 2020.
[14] K. Han, B. Shi, and X. Yan, "Study on evaporation inhibition rate of still water surface of plain reservoir in arid area covered by PE floating ball," *Journal of Water Resources and Water Engineering*, vol. 28, no. 04, pp. 235–239, 2017.
[15] Y. Cai, W. Wang, and M. Zhang, "Formation and evolution of main chemical components of surface water and groundwater in Turpan Basin," *Modern geology*, vol. 30, no. 03, pp. 680–687, 2016.
[16] X. Zhang, B. Shi, and X. Yan, "Study on water saving efficiency of plain reservoirs in inland arid area under group plate coverage," *People's Yangtze River*, vol. 46, no. 08, pp. 23–26, 2015.
[17] K. Han, B. Shi, and Y. Yang, "Study on water saving rate of plain reservoir in arid area covered by counterweight floating ball," *Geography of Arid Areas*, vol. 43, no. 03, pp. 644–651, 2020.
[18] X. Li, Q. Yang et al., *Water Conservancy Industry Standard of the People's Republic of China SL 72-2013 Specification for Economic Evaluation of Water Conservancy Construction Projects*, China Water Resources and Hydropower Press, Beijing, 2013.
[19] Y. Zhang, W. He, and J. Han, "Weight analysis of irrigation in agricultural yield increase benefit," *Northwest Water Resources and Water Engineering*, vol. 13, no. 01, pp. 15–18+23, 1998.
[20] S. K. Song and x. Yan, "Experimental study on EPS lightweight concrete for preventing evaporation in plain reservoirs in inland arid areas," *Journal of Yangtze River Academy of Sciences*, vol. 32, no. 04, pp. 125–128, 2015.
[21] X. Song and K. Shi, "Discussion on Application of color steel sandwich panel in evaporation prevention and water saving test of plain reservoir," *Xinjiang Water Resources*, vol. 09, no. 02, pp. 15–19, 2015.
[22] L. Song and K. Shi, "Discussion on Application of partition board in evaporation prevention and water saving test of plain reservoir," *Journal of Yangtze River academy of Sciences*, vol. 32, no. 07, pp. 35–39, 2015.
[23] Y. Cheng, B. Shi, and X. Yan, "Study on evaporation prevention of plain reservoirs in arid areas under free arrangement of PVC floating plates," *Water Conservancy Technology and Economy*, vol. 24, no. 06, pp. 9–14, 2018.