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# Study on the Water Conservation Effects of the Water Resources Tax Pilot Program in the Yellow River Basin--Taking Shanxi Province as an Example

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## ABSTRACT

China's water resources exhibit uneven regional distribution and persistently low per capita availability, with the Yellow River basin facing particularly acute water supply-demand imbalances. As ecological civilization construction has been elevated to a national strategy, water resource tax reform has emerged as a pivotal measure to advance ecological conservation and high-quality development in the Yellow River basin. As one of the first pilot regions, Shanxi Province has provided crucial practical insights for nationwide reform since implementing the water resource fee-to-tax conversion in December 2017. Therefore, this study focuses on the industrial sector in Shanxi Province to uncover the patterns of how water resource tax reform influences industrial water conservation outcomes. Current research on water resource taxes predominantly concentrates on institutional design, lacking systematic analysis of actual water-saving achievements. This paper innovatively introduces the DPSR model (Drivers-Pressures-State-Responses) into water resource tax research. It constructs a multi-dimensional evaluation system comprising 14 indicators and employs the entropy method and TOPSIS model to comprehensively assess data from industrial enterprises above designated size in Shanxi Province from 2015 to 2022. This aims to validate the industrial water conservation effects of the water resource tax reform. The findings reveal that the water resource fee phase (2015–2017) suffered from multiple issues, including excessively low levy standards. Following the water resource tax reform, significant outcomes emerged, with the policy effects exhibiting a “three-year lag and five-year manifestation” pattern. Although regional implementation disparities and inadequate supporting measures persist, the study demonstrates that the tax lever effectively compels enterprises to upgrade their technologies.

## KEYWORDS

Water Resources Tax; DPSR Model; Evaluation Indicator System

## 1. INTRODUCTION

China's water resources are unevenly distributed geographically, with low per capita availability, and the supply-demand imbalance in the Yellow River basin is particularly acute. Since the 18th CPC National Congress, the Party Central Committee has elevated ecological conservation and high-quality development in the Yellow River basin to a national strategy. The 20th CPC National Congress further proposed advancing its development and implementing water resource tax reform. In December 2017, Shanxi Province pioneered the pilot conversion of water resource fees into taxes. Nationwide implementation commenced on December 1, 2024. This study focuses on Shanxi Province within the Yellow River Basin, examining the water conservation effects of the water resource tax on industrial water use. It analyzes the underlying mechanisms influencing water consumption and supply structures, establishing an evaluation framework for assessment [1-3].

## 2. LITERATURE REVIEW

### 2.1. Research on the Overall Impact of Water Resource Tax Reform

Water resource tax reform, as a vital component of China's green tax system development, has profoundly impacted the optimization of water resource allocation and the promotion of green economic transformation. Zhao Lexin and Fang Hongsheng (2025) indicate that this reform effectively drives corporate green investment—particularly preventive green investment—by increasing environmental legitimacy pressure, with this effect being significantly evident across both upstream and downstream industries within supply chains [4]. Li Changchun (2024), based on research in Hebei Province, found that the reform significantly improved water use efficiency, optimized water consumption structures, and effectively curbed groundwater overexploitation [5]. Yao Peng and Li Jinzhe (2023) examined the reform's role in driving industrial transformation and upgrading from dual perspectives of resource allocation efficiency and technological compensation effects [6]. They argue that the reform promotes industrial upgrading by reducing the scale of water-intensive industries and stimulating green innovation.

### 2.2. Study on the Water-Saving Effects of Water Resource Tax Reform

Water conservation is a core policy objective of the water resource tax reform, with extensive micro- and macro-level evidence supporting this claim. Li Jing and Wang Zihao (2023) employed a difference-in-differences model using industrial enterprise data from Hebei Province, demonstrating that the reform significantly reduced corporate water consumption and enhanced water efficiency. The water-saving effects were particularly pronounced among high-water-consuming enterprises and in groundwater management zones [7]. Zhang Jiayang (2022) assessed the reform from a green total factor productivity perspective, finding that it significantly enhanced regional green development levels by improving water efficiency rather than merely reducing water consumption. This effect was more pronounced in provinces with large areas of efficient irrigation and strong wastewater treatment capacity [8]. Tian Guiliang and Gao Tingyan (2022) studied water-intensive industries and found that the reform effectively reduced water consumption per 10,000 yuan of GDP. Although its impact on suppressing total water use remains limited, technological progress and tax compliance pressures jointly drove improvements in water efficiency [9]. Liu Ye et al. (2022) used a multi-period difference-in-differences approach to validate the reform's promotional effect on corporate R&D investment, further revealing the economic incentive mechanisms underlying water conservation outcomes [10].

### 2.3. Summary

Water resource tax reform has played a positive role in promoting water conservation and protection, driving industrial transformation and upgrading, and incentivizing green investment by enterprises. However, responses to the reform vary across regions and industries, with water-intensive sectors and industrial enterprises often demonstrating stronger water-saving effects. Concurrently, existing research has highlighted challenges facing water resource tax reform, such as the need for optimized tax system design, difficulties in rural collection, and insufficient fiscal expenditure support. Future research should further examine the long-term effects and regional disparities of water resource tax reform, exploring more scientifically sound tax system designs and collection models to fully leverage the tax's role in promoting sustainable water use and green economic development. Moreover, given the unique characteristics of the Yellow River Basin, conducting in-depth analyses of the reform's water-saving impacts and policy optimization pathways in this region holds significant importance for advancing ecological conservation and high-quality development in the basin.

## 3. INDICATOR EVALUATION PROCESS

The study employs the DPSR model (Drivers-Pressures-State-Responses) to construct an evaluation system comprising 14 indicators across economic, environmental, and policy dimensions. Key elements include industrial value-added, water consumption per 10,000 yuan of output value, and investment in water-saving equipment. Indicator weights were determined using the entropy method, and the TOPSIS model was applied to conduct a comprehensive evaluation of data from industrial enterprises above designated size in Shanxi Province from 2015 to 2022.The specific evaluation indicator system is shown in Table 1 below.

**Table 1.** Evaluation index system of water resource tax effect on industrial water saving

| Target layer | The guidelines layer | Indicator category | Indicator layer |
|---|---|---|---|
| Evaluation of water-saving effect of water resource tax on industry | Driving force—D | Economic dimension | Resource tax revenue |
| | | Environmental dimension | gross amount of water resources |
| | Pressure—P | tax burden | Water taxes |
| | | Business load | Enterprise production cost |
| | State—S | Water consumption | Industrial water consumption |
| | | | Industrial groundwater consumption |
| | | Utilization of duty-free resources | Very water reuse ratio |
| | | Water saving equipment input | Total investment in urban water-saving measures |
| | Respond—R | Optimization of water structure | Industrial water consumption as a percentage of total water consumption |
| | | | The proportion of industrial groundwater in the total industrial water consumption |
| | | Awareness of water conservation increased | Industrial water conservation |
| | | | Industrial new water intake |
| | | Improved water efficiency | Water consumption per 10,000 yuan of industrial added value |
| | | | Industrial water reuse rate |

Driving force:As shown in Figure 1 below, resource tax revenue has shown an overall upward trend, with significant growth from 2015 to 2022, indicating that the regulatory role of tax policies in the economy is gradually becoming apparent.

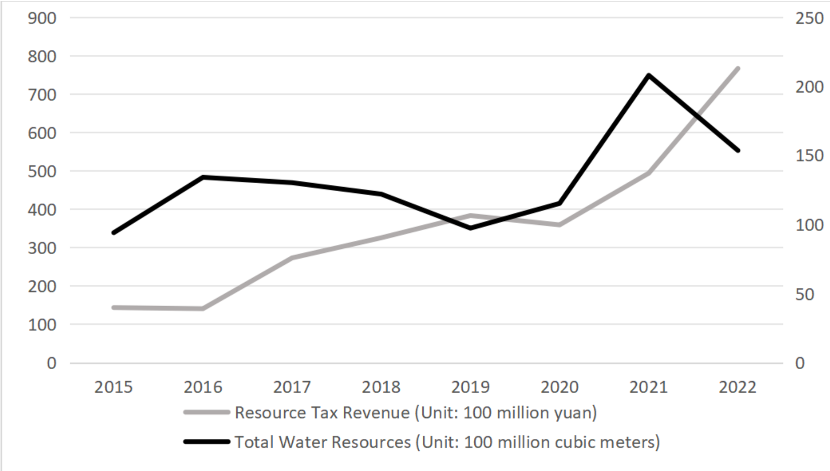


**Figure 1.** Driving Force D Trend Chart

Pressure: As shown in Figure 2 below, water resource taxes have increased annually, leading to a slight rise in corporate production costs, reflecting the regulatory impact of tax policies on corporate water usage practices.

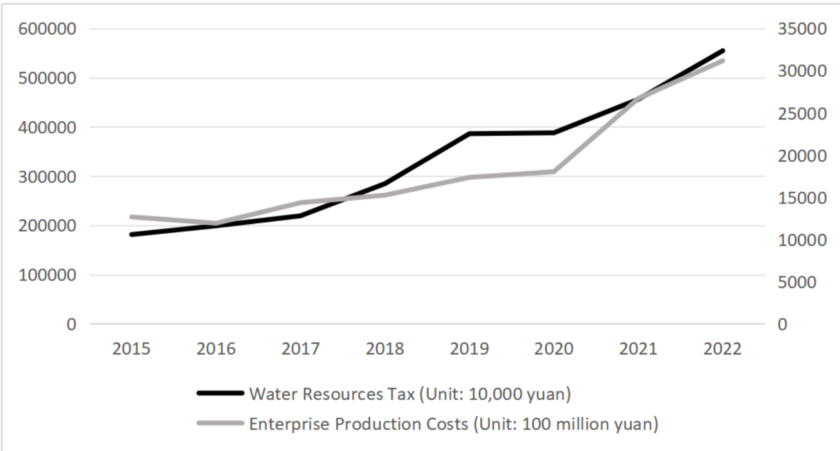


**Figure 2.** Pressure P Trend Chart

State:As shown in Figure 3 below, industrial water consumption and groundwater extraction have declined significantly, indicating that the water resource tax has effectively curbed water-intensive practices and promoted the efficient use of water resources.

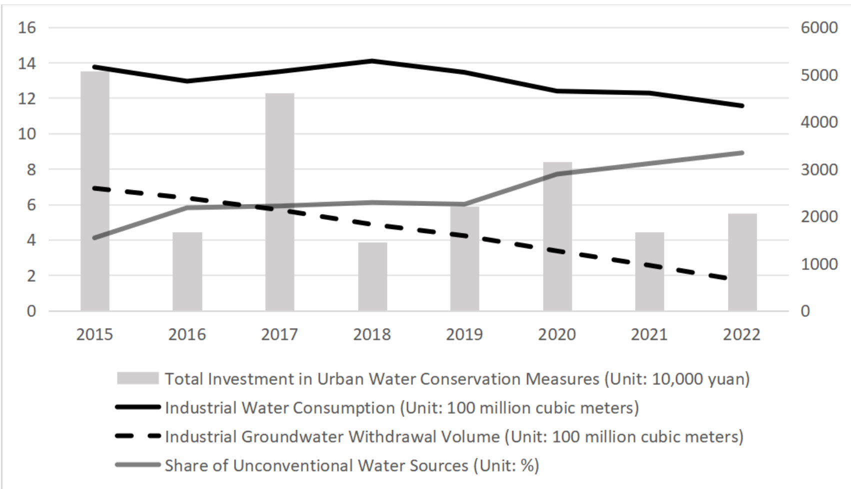


**Figure 3.** Status S Trend Chart

Response:

Water Use Structure Optimization: As shown in Figure 4 below, the proportion of industrial groundwater usage has been declining year by year, with a significant optimization in water consumption patterns. This indicates that the water resources tax has effectively guided enterprises to adjust their water usage structures and reduce reliance on groundwater.

Water Efficiency Enhancement: As shown in Figure 4 below, industrial water savings have increased significantly since 2018, indicating heightened water conservation awareness among enterprises, though further consolidation remains necessary.

Water conservation awareness is increasing: As shown in Figure 4 below, the annual water consumption per ten thousand yuan of industrial added value has been declining, indicating that the water resources tax has effectively promoted water use efficiency and advanced green industrial development.

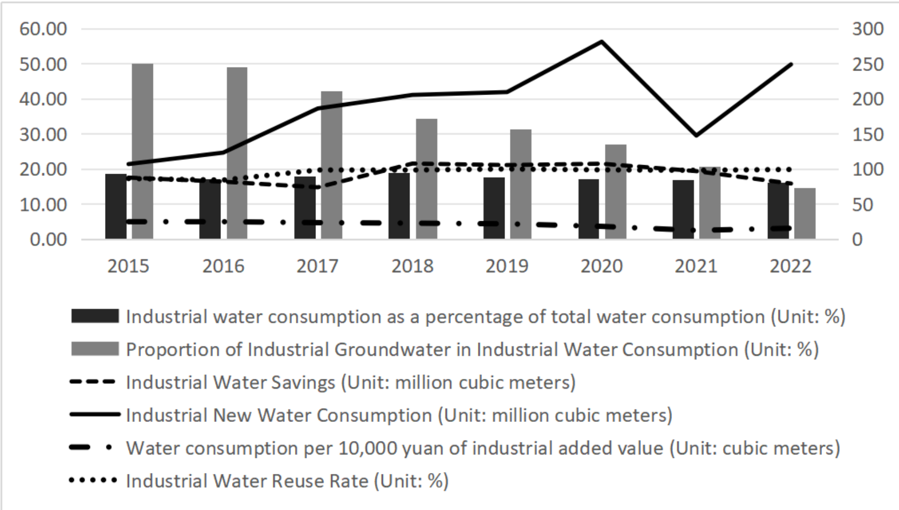


**Figure 4.** Response R Trend Chart

After determining indicator weights using the entropy method and calculating the optimal solution distance, worst solution distance, proximity, and ranking via the Topsis model, the results are presented in Table 2 below. The relative proximity Si for each evaluation indicator corresponds to its composite score. Proximity scores range from 0 to 1, where a higher Si value indicates a higher composite score for water-saving effects and greater proximity to the optimal level.

**Table 2.** Evaluation results of water resource tax effect on industrial water saving in Shanxi Province

| Year | Optimal solution distance D+ | The maximum dissonance distance D- | Proximity score Si | Ranking |
|---|---|---|---|---|
| 2015 | 0.2351 | 0.1347 | 0.3643 | 6 |
| 2016 | 0.2347 | 0.0890 | 0.2749 | 8 |
| 2017 | 0.1970 | 0.1291 | 0.3958 | 5 |
| 2018 | 0.2137 | 0.1084 | 0.3366 | 7 |
| 2019 | 0.1842 | 0.1256 | 0.4054 | 4 |
| 2020 | 0.1453 | 0.1589 | 0.5224 | 3 |
| 2021 | 0.1271 | 0.2071 | 0.6196 | 1 |
| 2022 | 0.1334 | 0.2151 | 0.6172 | 2 |

# 4. ANALYSIS OF EVALUATION RESULTS

As shown in Figure 5, during the period from 2015 to 2017, the comprehensive score for the water conservation effect of Shanxi Province's water resource tax on the industrial sector first declined and then increased. Following the transition from water resource fees to taxes in December 2017, the score for 2018 saw a slight decline compared to 2017. After 2018, the implementation effects of the water resource tax gradually became evident, with the comprehensive evaluation score rising annually. In 2022, there was a negligible, minimal decline. These changes fully demonstrate the significant effectiveness of Shanxi Province's water resource tax reform in promoting industrial water conservation.

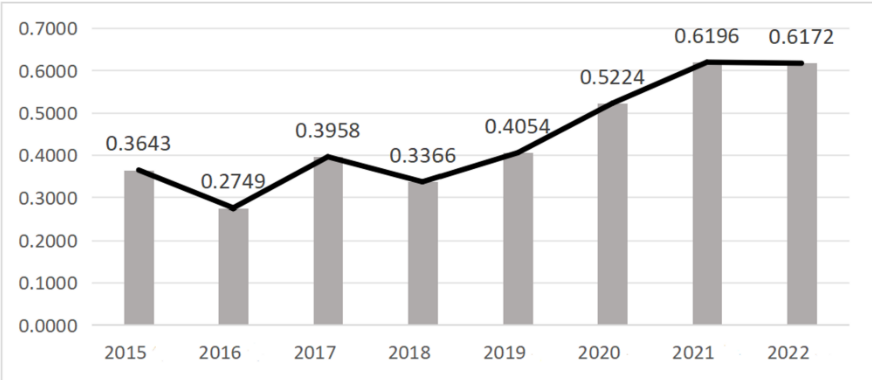


**Figure 5.** Comprehensive evaluation results

Through in-depth analysis, it is evident that multiple issues undermined the effectiveness of water resource fees collected in Shanxi Province between 2015 and 2017. First, the collection standards were set too low, failing to adequately reflect the actual value and scarcity of water resources through pricing mechanisms. In some regions, the collection of water resource fees became merely a formality, carrying only symbolic significance. This low-standard approach weakened industrial enterprises' awareness of water conservation, diminishing their motivation to conserve water during usage. Second, the water resource fee lacked differentiated collection standards. Whether for groundwater or surface water, planned usage or excess consumption, fees show no substantive differentiation. This one-size-fits-all approach fails to effectively guide enterprises toward rational water extraction and usage, hindering its role in preventing excessive groundwater extraction and reducing extraction volumes. Third, government departments exhibit irregularities and lax oversight in managing water resource fee collection, coupled with insufficient enforcement. This has led some enterprises to take chances by failing to pay water resource fees on time or in full, undermining the fee's ability to effectively constrain industrial water consumption and promote water conservation. Overall, the water resource fee has failed to achieve its intended outcomes during implementation, instead contributing to a continuous decline in the comprehensive scores of the industrial sector. Starting in 2017, China began implementing water resource tax reforms. However, due to policy implementation lags and regional variations in enforcement intensity, Shanxi Province, as a pilot region, did not achieve significant results that year. Over time, the advantages of the water resource tax gradually became apparent after 2018.

# 5. DISCUSSION

## 5.1. Enhancing the Evaluation of Water Resource Tax Implementation Effects

Analysis directly reflects the effects of reforms and provides robust data support for evaluating reform outcomes. To further refine the water resources tax system, it is necessary to establish a monitoring mechanism that closely tracks implementation dynamics and incorporates scientifically designed feedback points. Timely analysis and summarization of current implementation outcomes help clearly identify the strengths and weaknesses of pilot programs, clarifying which measures warrant continuation and which practices require refinement. Beyond the analysis of water resource tax's water-saving effects on the industrial sector, as highlighted in this paper, research perspectives can be extended to other domains. For instance, assessments can be conducted on changes before and after the conversion of water resource fees to taxes in other regions or specific representative industries. By comparing tax and fee revenues before and after the reform, it is possible to determine whether policy adjustments have imposed additional burdens on the local economy, thereby inferring the rationality of taxation standards. Furthermore, by enriching the dimensions of indicators and leveraging data comparison results, more references can be provided for policy optimization. Furthermore, the evaluation process should establish a clear milestone plan with regular assessment cycles. This facilitates the timely identification and correction of issues within the reform system, effectively mitigating risks of policy inapplicability, and propels the water resource tax reform toward more stable, refined, and in-depth development [11-12].

### 5.2. Establish a Platform Between Water Administrative Authorities and Tax Authorities

On December 1, 2024, the nationwide pilot program for water resources tax reform commenced. Current policy documents pertaining to water resources tax include the “Implementation Measures for the Pilot Program of Water Resources Tax Reform.” The Measures stipulate that water administrative departments shall regularly submit relevant water resources management information to tax authorities. This includes water withdrawal permits for water-using entities and individuals, water withdrawal measurement data or water withdrawal volume verification documents, information on illegal water withdrawals, water withdrawal plan details, and results of water withdrawal measurement inspections. Tax authorities shall periodically analyze and compare taxpayer-reported information with data submitted by water administrative departments. Where anomalies in reported water withdrawal volumes are detected, tax authorities may request water administrative departments to conduct reviews and adjust taxpayers' tax liabilities based on the review findings. Issues identified during water resource tax collection and administration shall be jointly verified by tax authorities and water administrative departments. It can be said that throughout the water resource tax collection process, the two departments are deeply integrated, establishing collaborative platforms and systems to effectively address issues such as time lags and asynchrony in information transmission. Additionally, it is recommended to further clarify specific scenarios for joint verification, collaborative obligations, and responsibility allocation through measures such as power lists, thereby defining the distribution of authority and responsibility between the two departments in ambiguous areas.

### 5.3. Discussion of innovation

Compared to studies primarily employing econometric models such as the double difference approach for effect identification (Li Jing et al., 2023; Liu Ye et al., 2022), this research introduces the DPSR model to construct a systematic evaluation framework, attempting to establish a comprehensive indicator system encompassing the “driving forces-pressures-state-responses” chain. This framework not only examines policy-induced changes in water consumption (state) but also focuses on analysing the underlying economic drivers, corporate pressures, and adaptive behavioural responses. This enables a more systematic and multi-layered measurement of reform outcomes. Furthermore, in terms of policy implications, this paper emphasises proposing optimisation recommendations based on process mechanisms. By dissecting the specific pathways through which tax burden pressures influence water use decisions and water source structures, this study aims to propose policy recommendations extending beyond tax system design itself. These encompass complementary monitoring systems and incentives for water source restructuring, thereby providing reference points for enhancing the precision and coordination of water resource taxation policies.

# 6. CONCLUSION

## 6.1. The Water Resource Charge Phase Presented Issues

This study identifies multiple issues within the water resource charge phase (2015–2017). Firstly, the levy standards were excessively low, failing to adequately reflect the actual value and scarcity of water resources through pricing mechanisms. Secondly, the water resource charge lacked differentiated collection standards. Substantive distinctions were absent in charging rates for both groundwater and surface water, as well as for planned versus excess water usage. Furthermore, government departments exhibited irregularities in collection management, lax oversight, and inadequate enforcement. Overall, the implementation of the water resource charge failed to achieve its intended outcomes, instead contributing to a consistent decline in the comprehensive assessment scores for the industrial sector.

## 6.2. Water Resource Tax Reform Has Significantly Boosted Industrial Water Conservation

This study found that during the pre-reform water resource fee phase, limited incentives for water conservation existed due to issues such as low levy standards. Following the implementation of the water resource tax reform, however, the strengthened constraints and guidance provided by the tax lever effectively compelled enterprises to undertake water-saving technological upgrades and enhance water use efficiency. Evaluation results indicate that the reform effects exhibit a sequential pattern of "three-year lag and five-year manifestation," suggesting that a certain transmission and adaptation period is required for the policy to generate comprehensive and stable water-saving outcomes from implementation to realization.

## 6.3. Current Reforms Fall Short in Regional Implementation and Systemic Coordination

Research indicates that the implementation effectiveness of water resource tax reform varies across different regions in Shanxi Province, and the coordination with related supporting measures requires strengthening. This aligns with the issues highlighted in the abstract, namely "regional implementation disparities and inadequate supporting measures." Therefore, to continuously enhance reform effectiveness and advance ecological conservation and high-quality development in the Yellow River Basin, future policy optimization should focus on establishing a tax rate standard system with greater regional differentiation and dynamic adjustment mechanisms. Efforts should also be made to strengthen the coordinated development of tax collection and administration alongside water resource monitoring, measurement, and related infrastructure. Furthermore, deeper integration of the water resource tax with relevant environmental protection policies should be promoted to form a systematic incentive and constraint mechanism for green development.

# REFERENCES


[1] Wang Y, Wang X, Wang H, et al. Impact of Water Resource Tax Reform on Total Factor Productivity of High-Water-Consumption Industrial Enterprises in China [J]. Water, 2025, 17 (8): 1208-1208.

[2] Lu H, Zhu Y, Kang Y. Water Resource Tax and Green Industrial Development: Reform from the Largest Emerging Economy [J]. Sustainability, 2025, 17(10): 4478-4478.

[3] Ju X, Liang Q, Yao P. Water Resource Tax Reform Promotes the Green Transformation of Resource-Based Cities in the Yellow River Basin [J]. Water Economics and Policy, 2025, 11(03).

[4] Zhao Lexin, Fang Hongsheng. Water Resource Tax Reform, Supply Chain Transmission, and Corporate Green Investment [J]. Comparative Economic & Social Systems, 2025, (04): 88-100.

[5] Li Changchun. Water Resource Tax Reform: Research and Reflections Based on the Experience and Effectiveness of Hebei Province [J]. Taxation Research, 2024, (05): 88-93.

[6] Yao Peng, Li Jinze. Production Determined by Water: Water Resource Fee-to-Tax Reform and Industrial Transformation and Upgrading [J]. Statistical Research, 2023, 40(08): 135-148.

[7] Li Jing, Wang Zihao. Research on the Effects of Water Resource Tax Reform from Dual Perspectives of Water Conservation and Emission Reduction: Evidence from Micro Industrial Enterprises [J]. Review of Industrial Economics, 2023, (06): 117-134.

[8] Zhang Jiayang. Evaluation of the Policy Effects of Expanding the Pilot Program for Water Resource Tax Reform: Based on the Perspective of Green Total Factor Productivity [J]. Sub National Fiscal Research, 2022, (10): 83-94.

[9] Tian Guiliang, Gao Tingyan. The Impact of Fee-to-Tax Reform on Water Resource Utilization Efficiency in High Water-Consumption Industries [J]. China Population, Resources and Environment, 2022, 32(09): 143-150.

[10] Liu Ye, Huang Shi, Huang Zhangyan. Can Water Resource Tax Reform Achieve a Double Dividend Effect? [J]. Taxation Research, 2022, (09): 55-63.

[11] Zhao Zhishang, Ma Hongmei, Bian Xiaonan. Analysis of the Effectiveness and Issues of the Water Resource Tax Reform Pilot: A Case Study of Dezhou, Shandong [J]. Sub National Fiscal Research, 2021, (07): 47-55.

[12] Yang Deqian, Zhao Lei, Yang Doudou. Does the Water Resource Tax Improve Water Efficiency? —Evidence from Hebei Province [J]. Taxation Research, 2020, (08): 36-42.