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The Current Development Status and Path Selection of China's Ice and Snow Infrastructure Under the Background of the Beijing Winter Olympics

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Abstract: With the successful hosting of the Beijing Winter Olympics, ice and snow sports in China have attracted greater attention from the public, and the construction of relevant infrastructure should also be further optimized. We should actively introduce new technologies and infrastructure to promote the further development of China's ice and snow infrastructure. In view of this, this paper analyzes the development of China's ice and snow infrastructure in the background of the Beijing Winter Olympics and puts forward some strategies, which are for reference only by colleagues in the field.

Keywords: Beijing Winter Olympics; Ice and snow infrastructure; Development; Current status and path

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1. The significance of the development of China's ice and snow infrastructure against the background of the Beijing Winter Olympics

1.1. Conducive to the construction of a sports power

With the successful hosting of the Beijing Winter Olympics, ice and snow sports in China have entered a new stage of development. A growing number of people have participated in ice and snow sports, which has laid a solid foundation for China to build itself into a sports power. Ice and snow infrastructure is an important part of China's strategic development; to a certain extent, it has also enabled the breakthrough and innovation of China's competitive sports technology, and laid a solid foundation for the grand goal of "300 million people participating in ice and snow sports" [1]. The construction of the Winter Olympics venue cluster has achieved a breakthrough in traditional sports facilities, making the single function and positioning more diversified. It can invisibly promote closer integration between public sports services and international event standards, and form a new sports space model with strong demonstration effects. Under this model, in addition to innovating

the previous forms of sports and training, it can also cultivate more high-quality talents for the country's ice and snow sports. Through the extension of some inclusive infrastructure, the national strategy of nationwide fitness can be better implemented [2]. In this process, the technological content, technical level, and service level of ice and snow infrastructure have become important criteria for the modernization of sports, and the quality of infrastructure development is closely related to China's goal of becoming a sports power.

1.2. Conducive to the dissemination of ice and snow culture

Against the background of the Winter Olympics, the development and construction of ice and snow infrastructure can enable people to spread ice and snow culture more effectively, allowing ice and snow culture to have a more far-reaching impact on more people invisibly. During the Winter Olympics, the construction of regional ice and snow sports centers and the use of technologies such as indoor ice rinks and artificial snowmaking can break the restrictions of geographical and climatic factors on ice and snow sports. This physical expansion can not only further expand the scope of ice and snow sports, but also enable more people to gain a new understanding of ice and snow sports, making activities originally limited to winter accessible throughout the year [3]. This year-round participation can help more people develop new interests in and understanding of ice and snow sports, encouraging them to more actively explore the culture and skills of ice and snow sports, creating more high-quality cultural communication scenarios, and enabling ice and snow sports to penetrate from professional competitions into daily life. This cultural transformation can not only upgrade people's concept of sports consumption but also invisibly enhance national cultural confidence, allowing ice and snow culture to penetrate into daily life at a higher level. Thus, it can invisibly build a sports culture system in the new era and provide a better path for the dissemination of ice and snow culture.

1.3. Conducive to enhancing modern governance capacity

Against the backdrop of the Beijing Winter Olympics, the development of ice and snow infrastructure can, to a certain extent, enhance the modern governance capacity of relevant authorities. This enables more rational utilization of ice and snow infrastructure and the establishment of a new institutional system with greater demonstration value. The cross-regional collaboration approach allows for wider application of ice and snow infrastructure, facilitating a higher level of integration between resources and the market. The Beijing-Tianjin-Hebei region can foster an environment characterized by industrial collaboration and joint ecological governance, laying a solid foundation for the implementation of various subsequent initiatives [4]. Furthermore, other northern regions can learn from the ice and snow infrastructure development experience of the Beijing-Tianjin-Hebei region, adapt it to their local realities, carry out reforms and optimizations, and replicate successful practices. By experimenting with different operation models, deeper integration between market resources and government public services can be achieved. This also helps establish a green technology standard system, promote low-carbon construction models, and set a demonstration example for the utilization of large-scale public facilities. These institutional achievements can not only be applied to ice and snow sports but also be practically used in other projects, providing new ideas and methods for the construction and governance of public-domain facilities.

2. Current development status of China's ice and snow infrastructure

2.1. Stock advantages and transformation dilemmas of Winter Olympic heritage

Against the backdrop of the Beijing Winter Olympics, China's ice and snow infrastructure faces certain issues

regarding transformation and stock advantages. After the Beijing Winter Olympics, there has been an oversupply in the number of such infrastructure facilities, which inadvertently consumes significant resources and incurs high maintenance costs. Failure to utilize ice and snow infrastructure reasonably will greatly hinder its future development [5]. In the construction of ice and snow infrastructure, intelligent management systems and modular design concepts have been applied, providing a certain foundation for the subsequent transformation of these facilities. However, there is a discrepancy between the positioning of many professional ice and snow venues and the actual needs of the general public, which easily leads to low utilization rates of ice and snow infrastructure. For some small and medium-sized ice and snow infrastructure facilities, seasonal fluctuations result in situations of insufficient supply and resource idleness. From a deeper perspective, a large number of people have not yet developed the habit of participating in ice and snow sports, and the public's initiative to engage in such sports is relatively low. These factors also inadvertently impede the development of ice and snow infrastructure.

2.2. The practical contradiction between ecological constraints and technological dependence

To a large extent, people can break through the limitations of natural conditions by using artificial snow-making. However, this also gives rise to new environmental challenges to a certain degree. Excessive development of natural ski resorts in northern China will lead to problems such as soil erosion and damage to mountain vegetation. In the long run, this will form a comprehensive ecological pressure together with the heat island effect and refrigerant pollution caused by artificial ice rinks in southern China, exerting an extremely adverse impact on the environmental development of our country [6]. Moreover, in the process of constructing ice and snow infrastructure, there are also issues like excessive consumption of water resources and energy. The daily water consumption of some ski slopes can reach hundreds of tons, and the corresponding refrigeration systems will invisibly increase the regional energy load, even affecting the electricity use of surrounding residents. This development model has a significant impact on the natural ecology and is inconsistent with China's concept of sustainable development. How to reduce the impact on the environment while developing ice and snow infrastructure has become an important issue that needs to be addressed urgently. Some regions have solved the problem of insufficient water resources by collecting rainwater, and can also use models such as photovoltaic power generation to address the issue of energy shortage. However, large-scale promotion is still restricted by technology and costs.

2.3. Structural defects in the safety guarantee system

In ice and snow sports, safety is a key issue that requires attention. During the development of ice and snow infrastructure, there is a problem of insufficient safety guarantee systems. Accidents often occur in actual ice and snow sports, which greatly hinders the application of ice and snow infrastructure. Ice and snow sports themselves carry relatively high risks. If the safety guarantee capacity of infrastructure is insufficient, it will have a major impact on the development of subsequent work [7]. In the construction of ice and snow infrastructure, there is an imbalance between safety and professionalism. These problems are mainly reflected in the unreasonable setting of slope gradients, insufficient design of buffer zones, and the lack of corresponding protective devices—all of which reduce the safety of people participating in ice and snow sports. In addition, in the construction of many ice and snow infrastructure projects, professional rescue personnel are not equipped, and the update of various first-aid equipment is also insufficient. This makes it difficult to rescue the injured on time when dangers occur, which also increases the psychological threshold for participating in ice and snow sports to a large extent. If

safety problems occur at ice and snow venues, the operating entities may be involved in legal disputes, which will also hinder the popularization of ice and snow sports to a certain extent.

3. Development paths of China's ice and snow infrastructure

3.1. Establishing a full-cycle sustainable development mechanism

Against the background of the Beijing Winter Olympics, to further promote the development of China's ice and snow infrastructure, it is essential to establish a more rational and scientific sustainable development mechanism. This will lay a solid foundation for future work and ensure the rational use of resources. To this end, relevant departments can establish a more reasonable management system, well manage the planning, operation, and evaluation of ice and snow infrastructure, and provide more flexible space for venue planning, which can further optimize the venues. In practice, a modular approach can be adopted for the construction and development of ice and snow infrastructure to enhance its adaptability. To further improve the application effect of ice and snow infrastructure, it is necessary to adhere to the concept of "four-season operation" in design and related work. By introducing projects such as land curling and roller skating, the seasonal fluctuations of venues can be reduced, ensuring the rational use of ice and snow infrastructure in all seasons [8]. In addition, we also need to optimize and expand the evaluation system, so that more resources can be reasonably used in the construction of ice and snow infrastructure, enabling ice and snow venues to exert greater social benefits. At the same time, in the evaluation process, the scope of evaluation content should be further expanded, and factors affecting the ecology should be included in the evaluation items. This can realize the dynamic monitoring of the ecological environment and form a better feedback mechanism. Based on local actual conditions, the government can foster some new ice and snow consumption industries. By integrating ice and snow sports with rehabilitation and education, the multi-dimensional expansion of the value of ice and snow infrastructure can be achieved.

3.2. Promoting the parallel development of green technology innovation and ecological compensation

Against the background of the Beijing Winter Olympics, to further improve the development effect of ice and snow infrastructure, we should promote the application of green technology. This can realize ecological protection, thereby achieving the parallel development of green technology and ecological protection. In the construction of ice and snow infrastructure, attempts can be made to introduce some low-energy water snow-making systems, which can significantly reduce resource waste and thus improve the green level of ice and snow infrastructure. In addition, we can also try to introduce biodegradable antifreeze agents and natural cold source technology into the development of ice and snow infrastructure. This can realize the carbon footprint tracking of ice and snow infrastructure and ensure the rationality and scientificity of the construction of ice and snow infrastructure [9]. In some ecologically sensitive areas, the method of building area replacement can be used to carry out work. While constructing ice and snow venues, some ecological restoration projects can be carried out to provide certain recovery resources for the ecosystem. Moreover, we can also try to establish a regional water resource quota trading mechanism, adjust water demand through market-oriented means, integrate green technology into spatial territorial planning, formulate red lines for ecological protection, ensure the rational layout of the ice and snow industry, and make the environmental carrying capacity compatible with ice and snow sports.

3.3. Improving the standardization of the safety assurance system

To further enhance the development effectiveness of ice and snow infrastructure, we should attach importance to the construction of a safety assurance system, formulate a more reasonable and scientific equipment safety plan, ensure that personnel allocation meets relevant national requirements, and establish a safety certification system based on venues of different levels. In addition, we need to actively promote intelligent protection systems and use technologies such as the Internet of Things (IoT) and big data to monitor the ice quality of ice and snow venues, personnel conditions, equipment status, etc., to promptly address potential risks [10]. In practice, a higher-quality rescue team should be introduced to ensure that more professional rescue forces fully cover ice and snow venues. This can significantly improve the safety of ice and snow sports and lay a solid foundation for the development of various ice and snow sports in the future. Different ice and snow venues can also develop specific insurance mechanisms based on their sports programs, and improve the level of sports safety and the risk resistance capacity of the venues through cooperation with insurance companies [11]. For employees working in ice and snow infrastructure, timely safety training and drills should be provided to greatly enhance their safety awareness and risk response capabilities.

3.4. Cultivating interdisciplinary talents and developing an innovative education system

Against the backdrop of the Beijing Winter Olympics, ice and snow sports in China have achieved long-term development, and the demand for various types of related talents has increased significantly. This requires us to cultivate more interdisciplinary talents and further optimize the talent cultivation and innovation system [12]. To this end, schools can offer more disciplines related to ice and snow sports and ice and snow facility management, and achieve a more in-depth integration of disciplinary knowledge with ice and snow sports, which can greatly improve the effectiveness of talent cultivation. Vocational colleges can establish majors related to ice and snow sports and develop a certain hierarchical certification system, and inject more talent into ice and snow sports through school-enterprise cooperation [13]. For basic education, more activities like “Ice and Snow Sports Entering Campus” can be carried out. By means of AI technology, Internet technology, etc., students can be taught about the history, types, and culture of ice and snow sports, breaking the constraints of region and season, and enabling students to gain a deeper understanding of ice and snow sports [14]. In addition, retired ice and snow athletes can transition into teachers in schools, which allows them to better play their roles and cultivate more talent for ice and snow sports.

3.5. Establish a multi-dimensional ice and snow culture dissemination network

To further enhance the development level of ice and snow technical infrastructure, we should strive to promote the dissemination of ice and snow culture, which also serves as the foundation and prerequisite for encouraging more people to participate in ice and snow sports. With the continuous advancement of China’s Internet technology, we can leverage virtual reality (VR) technology to support the dissemination of ice and snow culture, creating high-quality experiential scenarios. This approach can significantly boost people’s acceptance of ice and snow sports and lower the cognitive threshold for participation [15]. Ice and snow venues can collaborate with schools to organize winter camps for students, helping them gain a deeper understanding of ice and snow culture and enhance their awareness of ice and snow sports.

4. Conclusion

In summary, against the backdrop of the Beijing Winter Olympics, to further improve the development

effectiveness of ice and snow infrastructure, we can analyze and implement measures from the following aspects: establishing a full-cycle sustainable development mechanism; advancing the parallel implementation of green technology innovation and ecological compensation; improving the standardized construction of safety guarantee systems; fostering interdisciplinary talents and innovating education systems; and establishing a multi-dimensional ice and snow culture dissemination network. These efforts will implicitly drive further improvements in the development quality of ice and snow infrastructure.

Disclosure statement

The author declares no conflict of interest.

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