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Key Pathways to Achieve Sustainable Development Goals in Three Polar Regions

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Abstract: Due to the local and natural characteristics of high latitude and altitude in the Three Polar Region (TPR)—that is, the Antarctic, the Arctic, and the Qinghai-Tibet Plateau (QTP)—this region has been significantly affected by climate change and related disasters. Thus, the sustainable development pathway for the TPR is different from that of other regions. The Antarctic region, as a public territory, experiences sustainability problems that are mainly the result of the integrated impact of tourism and scientific and commercial fishing activities on the continent and ocean. Understanding how to build a shared, co-built, and co-governed, legally binding and equal international multilateral partnership or treaty, and thereby reducing the impact on water life and on land life, is the key pathway to achieving the Antarctic sustainable development goals (SDGs). The Arctic region has both a high level of development at the national level and a low level of development within the country, including the livelihood of indigenous people. Learning how to effectively deal with the domestic development imbalance in the future is a key pathway to achieving Arctic SDGs. The QTP has a fragile ecology and a single industry. As a relatively poor area in China, the ability to promote ecological protection and improve people's welfare through ecological policies is a key pathway to achieving the SDGs in the QTP. At the same time, the TPR also needs to enhance its climate resilience through climate action to mitigate the impacts of climate change. On this basis, to fully achieve the SDGs in support of the TPR, it is necessary to establish and pursue multilateral cooperation in science research, infrastructure, commerce, energy, and mining trades. As an important part of the climate system, spatial and temporal changes in the TPR have direct and indirect impacts on the global climate and other spheres (e.g., Anthroposphere) and also affect the global sustainable development process. Therefore, through the TPR's linkage and multilateral cooperation, the region can simultaneously enter the global sustainable development track.

Keywords: Antarctic; Arctic; Qinghai-Tibetan Plateau; sustainable development; key pathways

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1. Introduction

The Three Polar Region (the TPR) refers to the Antarctic, the Arctic, and the Qinghai-Tibetan Plateau (QTP). This region is also the major distribution area of the global cryosphere. The TPR is the region most intensely impacted by global climate change. These regions typically experience a multilayer interaction of the global climate system, and also are particularly sensitive regions affecting global climate and environment change. Among the 17 critical elements of the climate system, 11 are highly correlated with the TPR cryosphere, and each critical element has a cascading effect. The synergistic influence on the climate will be irreversible when the global temperature is above 4 °C [1]. For example, extreme warming in the TPR and the accelerated melting of the cryosphere have led to more extreme weather events around the world. The TPR has a profound impact on the regional eco-economic system. Through the remote and cascading effects of climate change, the TPR has also affected the hemispheric and global economic and social systems [2]. The accelerated melting of the cryosphere has revealed the resources, shipping lanes, and military and geostrategic value of the TPR.

Sustainable development is broadly defined as "development that can meet the needs of the present generation without jeopardizing the ability of future generations to meet their needs." It has "three dimensions"—namely, environment, economy, and society [3,4]. Due to the amplifying effect of the TPR's climate, it has had a significant impact on the climate [5]. Climate Action (SDG 13) can enhance the resilience of climate change and mitigate the negative impacts, which is a common pathway for the TPR to achieve the sustainable development goals (SDGs). The TPR, however, is located at high latitudes and altitudes, with significant differences in resource endowments and different intensities of human activities. This, in turn, has demonstrated that the TPR must be differentiated in its pathway to achieving the SDGs. Antarctica, as the global commons, is the "common heritage of mankind". Human activities are weak in Antarctica and currently are limited to tourism and scientific investigation. Therefore, it is an ideal place to make use of the Antarctic Treaty, promote global partnerships (SDG 17), and promote peaceful and sustainable use. Strictly adhering to the Antarctic Treaty will ensure the stability of the Antarctic continent and the Southern Ocean ecosystem (SDG 14, SDG 15). The Arctic countries are developed countries with a high level of sustainable development in their society, economy, culture, resources, and environment [6,7]. However, the economic development of the Arctic region in these countries lags behind the national level as a whole, so to deal with interregional development imbalance (SDG 10) is the main goal of the future development. The QTP, as the water tower of Asia, sustains the livelihoods of about 2 billion people downstream and is critical to the livelihoods of people in the middle and lower reaches, providing clean energy and food security. The QTP, however, has a high altitude, fragile ecosystem, single industry, and limited ability to cope with the impact of climate change (SDG 13) [8,9]. In the future, protecting the QTP ecosystem and improving people's welfare are the main goals of sustainable development.

In recent years, relevant research on the sustainable development of the TPR has focused mainly on the following aspects: (1) assessment of the realization of SDGs by Polar countries or regions (mainly involving European Arctic countries) [10]; (2) the interaction of the SDGs among Polar countries or regions [11]; and (3) the correlation and cascading effects between Polar cryosphere elements and sustainable development [12–14]. According to existing studies, the current SDGs do not reflect a sufficient understanding of the TPR, and corresponding sustainable development indicators should be added according to the special conditions of the TPR [15]. Although studies have examined sustainable development, few studies have coordinated and compared the key issues of the TPR's sustainable development and its realization pathway, and even fewer studies have examined the key pathways of the TPR linkage to promote sustainable development. The environment and sustainable development problems of the TPR are different than those in other regions, and the sustainable development pathways choices are similar but also different. According to past research results, in this study, we proposed the key pathways for the TPR to achieve the SDGs and suggested ways to enhance the level of sustainable development. This study holds great practical significance to promote multilateral cooperation between polar and non-polar countries to achieve equally beneficial SDGs.

2. Antarctic Region

As a public domain, Antarctica's continental and marine ecosystems are the basis for sustainable human use. Under the current conditions of international politics, international relations, and an international legal system, the ability to strictly adhere to the Antarctic Treaty System (ATS) and establish an equal international partnership or support international cooperation institutions that share, jointly build, and jointly govern will be a key pathway to achieving the SDGs. At the same time, the ATS and the establishment of protected marine areas should be set as constraints to promote the sustainability of scientific investigation and tourism activities and promote the health and stability of marine ecosystems.

2.1. Strictly Observe the ATS and Promote Humankind's Peaceful Use of the Antarctic Continent

Antarctic sustainable development is subject to and has benefited from the constraints and timeliness of the ATS, but this development may also become a new focus of strategic competition. For example, the United States supports the construction of icebreakers and deeper participation in Antarctic cooperation mechanisms, particularly in the Antarctic Treaty. Russia regards Antarctica as a strategic destination and has increased its financial investment in its involvement in Antarctic affairs and blocks the creation of the world's largest marine-protected area in Antarctica. The United Kingdom has maintained the closest permanent military base to Antarctica, in the Malvinas Islands, or Falkland Islands, where it considers itself to be a major power. France has linked its claim to Antarctica to its interests in the South Pacific and the Indian Oceans, collectively known as the "French Southern and Antarctic Territories," as part of a broader Indo-Pacific power strategy, and has strengthened its extensive fishing rights in this exclusive economic zone. The current "occupation" of the world's nations may well be a prelude to whether Antarctica's status as a "public possession" will become a "domain of great power contention."

The Antarctic Treaty is the foundation of Antarctic governance and sustainable development. With scarce energy and mineral resources in high demand, world powers are likely to start new negotiations on the Antarctic Treaty, seeking to approve more commercial activity before the moratorium expires. To this end, the Antarctic Treaty (SDG 16, SDG 17) should be strictly observed and extended to the maximum extent or indefinitely. Additionally, the mining of energy and mineral resources in Antarctica should be prohibited and the establishment of military bases in and around Antarctica should be banned. On the other hand, international organizations with scientific or technological interests in Antarctica should be encouraged to establish cooperative relations, promote international cooperation in scientific research and activities in Antarctica, and raise the level of scientific research in exploring and understanding the Antarctic continent to promote humankind's peaceful utilization of the continent.

2.2. Promote the Sustainability of Scientific Investigations and Tourism Activities under the Constraint of the Antarctic Treaty

Antarctica is not part of any country and has no regular resident population. According to the Council of Directors of the National Antarctic Bureau (COMNAP) and the Scientific Committee on Antarctic Research (SCAR), two international organizations, more than 100 Antarctic Scientific Research Stations and other Antarctic facilities are currently active. In addition to scientific research stations, countries have built camps, airports, shelters, and warehouses in Antarctica [15]. The number of scientists from around the world stationed in Antarctica varies from 1000 to more than 4000, depending on the station during the year and the station during the summer. In particular, in the 2018–2019 tourism season, 55,489 people arrived in Antarctica, an increase of 7% over the previous year [16]. Scientific investigations and tourism activities are the most important human activities in the Antarctic region. If they are not governed by the Antarctic Treaty, they are likely to cause environmental impacts.

To this end, relevant scientific investigations and tourism activities should strictly follow the ATS, and their activities should not damage the ecological, marine, atmospheric, or surface environment. Construction, operation, and maintenance of scientific research stations and field camps, scientific investigations, and tourism activities should be conducted in strict accordance with the 1964 "Agreed Measures for the Conservation of Antarctic Fauna and Flora" and all consultation countries in the following binding conditions: the 1991 approved "Protocol to the Antarctic Treaty on Environmental Protection", "Antarctic Environment Assessment," "Antarctic Wildlife Protection", "Antarctic waste treatment and management", "to prevent Marine pollution", "Antarctic Specially Protected Areas" and six annexes. Protecting the Antarctic environment and promoting scientific research and tourism are not contradictory issues. In the future, scientific investigations and tourism activities should establish a strict environmental impact assessment system and legally binding mechanism and should strictly prohibit human activities from "violating the natural environment of Antarctica," control the number of tourists, and forbid the dumping of waste into the Antarctic continent and sea area to avoid having a negative impact on the Antarctic environment [16].

2.3. Establish Marine Protected Areas to Promote the Healthy Development of the Antarctic Marine Ecosystem

Global marine ecological crises have been well documented, ranging from coral reef bleaching to peak fishing and from marine debris to micro-plastics. At present, the Antarctic marine ecosystem lacks a systematic assessment [17]. At the same time, with the development of the shipping industry, human activities on the high seas have been further expanded, and the scope of commercial fisheries has been moving deeper and deeper into the high seas, which has an impact on marine biodiversity in areas outside the national jurisdiction (more than 200 nautical miles from the coast) [18]. Climate change, deoxygenation, and ocean acidification exacerbate these impacts (SDG 14) [19,20]. Therefore, the establishment of marine-protected areas can actively promote the healthy development of the Antarctic marine ecosystem by strengthening research on the Antarctic ecology and environment and by improving the acknowledge of the scientific level of the Antarctic marine ecosystem [21].

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) (established in the 1980s) is a leader in the field of marine conservation. In 2005, CCAMLR began discussions on the construction of a network of marine-protected areas around Antarctica in response to the Johannesburg World Summit on Sustainable Development initiative for a representative network of marine-protected areas. Starting with the workshop, the plan was gradually presented to the working group of the Scientific Committee for discussion, and then developed into a concrete proposal, which finally was considered by the committee. The South Orkney Islands Southern Continental Shelf Marine Protected Area was established in 2009 and the Ross Sea Regional Marine Protected Area (SDG 14) was established in 2016. More recently, geopolitical and fishing interests have prevented several marine-protected areas (protected areas in the South East Pole, the Weddell Sea, and the South West Pole Peninsula) from being approved. Despite the creation of the Ross Sea Reserve, its management and scientific research plans have stalled.

In the future, to enhance the sustainable utilization and conservation of Antarctic marine biodiversity, the establishment of marine-protected areas should be actively promoted, the international cooperation orientation of these protected areas should be standardized, the scientific research cooperation and protection mechanisms among countries should be detailed, and the monopolistic utilization of protected areas should be avoided.

3. Arctic Region

Some four million indigenous Arctic peoples (approximately 10% of the region's population) have been and continue to be active guardians of this vast territory and its natural resources and environment [22]. As a result of the impact of climate change, the livelihood, welfare, and health of indigenous peoples has been seriously affected (SDG 13). The primary issue for future sustainable development in the Arctic is the imbalance of regional development within countries (SDG 10). In light of the existence of high seas and the enrichment of energy and mineral resources in the Arctic, it is necessary to continuously strengthen international cooperation and agreements (SDG 16, SDG 17) to promote the sustainable development process of resource utilization, shipping safety, and environmental protection in the Arctic. At the same time, it is also important to actively address the impact of climate change (SDG 13) so that the Arctic region can achieve the SDGs.

3.1. Effectively Deal with the Imbalance of Domestic Development and Promote Regional Balanced and High-Quality Development

The eight Arctic nations are among the world leaders in sustainability, but they still need to address imbalances with indigenous peoples' regions. This imbalance not only pertains to the imbalance of the economic base but also involves a series of imbalance issues, such as population distribution, educational resources, industrial layout, road network construction, and resource development (SDG 10). The Arctic has huge reserves of energy and mineral resources. With the opening of the Arctic shipping route, its rich resource potential will bring huge economic benefits. At present, however, the income from energy and mineral resources in the Arctic region is far from serving the basic welfare needs of indigenous people. The sustainable development of indigenous peoples in the Arctic has a direct bearing on the health and well-being of Arctic countries and humankind as a whole. The Arctic region has a relatively small population, backward infrastructure, and insufficient socioeconomic development conditions. By 2030, the Arctic population will grow by only 4% [23]. It is clear that the Arctic will not be a thriving source of labor, compared with the 29% increase in the global population expected over the same period. The 2018 Business Index North report noted that the region is facing the twin challenges of losing a young workforce and experiencing a gender imbalance. Many young people are moving south for education and employment reasons.

The use of state finance transfers and investments is an effective way to solve this regional development imbalance. Financial transfer payments can narrow the imbalance within Arctic countries in education, research, culture, economy, trade, and tourism, while investment can improve the conditions for the development of energy and mineral resources and promote the high-quality development of indigenous peoples and their industries. For example, to support healthy and vibrant northern communities, the Canadian government provides nearly CAD 2.5 billion dollars each year to territories through Territorial Formula Financing, which allows the territorial government to fund projects such as hospitals, schools, infrastructure, and social services. This support has effectively improved housing, medical, and educational conditions for indigenous peoples, contributing to the health and well-being of the northern population (SDG 3). At the same time, Canada provides substantial and growing funding support to the territories through transfer payments, including the Child Education and Post-Secondary Education Program (SDG 4). These territories also receive targeted federal support to address the particular challenges of the Northern Territories, addressing issues such as labor market training, infrastructure, and community development, clean air, and climate change.

3.2. Carry out Multilateral Cooperative Research to Promote Sustainable Development of the Arctic

Climate warming has greatly improved the conditions for the exploitation of Arctic resources and brightened the prospects for the development of Arctic shipping routes. Climate change has made navigation between Europe and Asia easier, and transportation of equipment, resources, and other goods related to resource extraction will become more frequent. Because of climate change, the improvement of exploitation conditions of oil, gas, and other resources has not only caused competition between Arctic countries and companies but also triggered the deep-seated resource insecurity. The exploitation of Arctic resources and environmental protection is always in contradiction. The Arctic Council and its member states adhere to the principle of sustainable development in resource exploitation. Arctic resource exploitation, however, has adversely affected the traditional hunting, fishing, and gathering of indigenous peoples [24]. Indigenous peoples are experiencing the most direct impacts of climate change on their homes and are also facing increasing pressures from natural resource exploitation.

Through military and energy routes, the Artic will lead and affect the future geopolitical pattern of the world. The development of science and technology, the response to climate change, commerce, tourism and human activities will continue to be highly dependent on the Arctic countries and the northern channel. The world will pursue all aspects of a multilevel and ongoing race of energy and mining, economy and trade, and geography in the Arctic [25]. The Arctic issue has exceeded the scope of Arctic states and regions. It now concerns the interests of non-Arctic states as well as the overall interests of the international community, including the division of Arctic resources, territory, sea and continental shelf, and military utilization and jurisdiction over shipping routes. It is fair to say that the future of the Arctic is full of great uncertainty [26]. Therefore, the Arctic states and non-Arctic states need to abandon conflicts of interests, pursue multilateral cooperation, and embrace the idea of a community with a shared future to properly handle the ecological security, resource security, environmental security, and geo-security issues in the Arctic region [27]. In particular, learning from the Antarctic Treaty, establishing the Arctic Treaty system, and promoting the peaceful use of the Arctic is an effective way to promote the sustainable development of the Arctic. Among these agreements, the Spitsbergen Treaty and the Agreement for the Prevention of Unregulated High Seas Fisheries in the Central Arctic Ocean are among the most successful.

Climate change continues to drive changes in the Arctic ecosystem as well as political, economic, and geopolitical relationships. Bilateral or multilateral cooperation between countries within and outside the Arctic region on scientific research, environmental protection, resource development, and geopolitical interests [28] would effectively promote sustainable development in the Arctic region (SDG 17). Bilateral or multilateral international cooperation can promote, support and expand converging interests and build shared interests with relevant parties on Arctic governance and SDGs [29]. For example, on 3 July 2017, President Xi Jinping and Russian President Vladimir Putin proposed to cooperate on Arctic shipping routes to jointly build an Ice Silk Road. The transport ministries of the two countries are negotiating a memorandum of understanding on maritime cooperation in polar waters between China and Russia to continuously improve the policy and legal basis for cooperation in Arctic development. During the 21st century, as the most influential international multilateral governance mechanism in the Arctic region, the Arctic Council has continuously strengthened its functions and institutional reforms, continuously strengthened its enforcement power and legal binding force, and demonstrated a successful transformation from an intergovernmental cooperation forum to a regional international organization [30,31].

3.3. Enhance Arctic Climate Resilience and Mitigate the Effects of Climate Change

In recent decades, against the backdrop of global warming, the Arctic region has experienced a warming phenomenon that is two to three times faster than the global average warming amplitude. This phenomenon is called the "Arctic amplification" effect. As warming is accelerating, Arctic sea ice is melting at an accelerated rate [32]. Since observations began in the 1970s, long-term loss of coastal sea ice has altered the basic characteristics of ecosystems, leading to the loss of habitat for animals that are highly dependent on sea ice [33] and affecting the decline of polar bear populations. At the same time, it has affected the hunting, travel, and coastal protection of local communities [34]. With the rapid warming of the Arctic, the frequency of extreme weather and climate events, such as explosive cold waves, heat waves, floods, and persistent droughts, has increased significantly at the mid and low latitudes of the northern hemisphere [35]. With the outbreak of marine algae, the increase in fire risk, and the degradation of permafrost, the living environment and infrastructure of indigenous peoples face medium- and high-level risk. These extreme events often result in significant environmental pollution, as well as indigenous diseases, casualties, and economic losses (SDG 13). The Arctic has become the region most affected by global climate change [36–38]. As a result of climate change, the Arctic eco-social system has undergone rapid changes which have seriously threatened the integrity and sustainability of the system [39]. The Arctic eco-social systems are irreversible, and climate change already has resulted in significant change. Great effort and money will be required to reduce or eliminate these negative impacts in the future [40]. Accordingly, the ability to improve the resilience to climate change and mitigate the impact of climate change is an important pathway to promote the achievement of the SDGs in the Arctic region.

The Intergovernmental Panel on Climate Change (IPCC) report defined the climate resilience pathway as a sustainable development trajectory that could mitigate climate change and its impacts through a combination of adaptation and mitigation. The IPCC noted that adaptation and mitigation are the two basic pathways to build climate resilience and that the application of resilience concepts could enhance the resilience of socioecological systems to cope with expected changes and emergencies (SDG 13.1) [41]. When existing mitigation and adaptation measures do not respond well to risks to the eco-social system in the Arctic, it is critical to proactively "transform". Transformation requires the fundamental change of existing policies, institutions, decision-making procedures, human behaviors, and even cultural values [42]. Arctic climate change often has cascading effects, and it is necessary to increase the monitoring and assessment of data on climate change and its impacts and then to propose early warning and decision-making systems. These assessments and systems are the basis and key to strengthening climate change resilience in the Arctic. To improve climate change resilience, it is necessary to identify the key drivers of climate change impacts, strengthen collaborative research on climate change and human activities [43], conduct multidisciplinary dialogues with different stakeholders, explore potential solutions to strengthen resilience, comprehensively assess the costs and benefits of implementing different options, and finally propose an optimal decision-making plan [44]. Furthermore, the improvement of climate resilience (SDG 13.1) requires the integration of mitigation and adaptation strategies into national policies, strategies, and regulations (SDG 13.2).

4. Qing-Tibetan Plateau

The QTP is known as the roof of the world, the water tower of Asia, and the third pole of the earth. Thus, it profoundly affects ecological security on national and global scales [45]. Its harsh and sensitive and vulnerable natural environment has restricted local economic and social development for a long time, and sustainable development has become an inevitable requirement to consider economic and social development and ecological protection. Like the Antarctic and Arctic, the QTP is warming much faster than the global average. Although the QTP contributes little to global carbon emissions, the impact of climate change is significant [46,47]. In the context of global warming, the QTP cannot be "left alone" [48]. At present, the implementation of ecological policies is a key pathway to achieve a series of SDGs and to promote the protection of its plateau ecology and improve human welfare.

4.1. Ecological Policies Help the Ecological Protection and the Improvement of Human Welfare

Ecological policies have greatly enhanced the ecological barrier function of the QTP and effectively promoted the achievement of the 2030 SDGs [49]. Since 1978, the QTP has implemented a large number of ecological policies, which have effectively curbed ecological degradation and improved the welfare level of herders. The improvement in the annual mean NDVI is more pronounced in protected areas than in non-protected areas, and the earlier the protected areas are established, the more significant the greening effect (SDG 15). Moreover, ecological conservation has not slowed down improvements in human welfare. Conversely, human welfare has improved markedly as a result of ecological policies (SDG 3). This improvement in human welfare is not only about income but also about health and education [50]. The Human Development Index (HDI) is the average value of standardized indices for health, education, and income, which comprehensively reflects the level of human welfare. From 1978 to 2017, the HDI of the QTP increased by 0.095 per 10 years, reaching 0.696 in 2017. This HDI, however, was still lower than the overall level of 0.75 in China and 0.73 globally. The ecological policies in the QTP directly serves SDG 1 (no poverty), SDG 2 (zero hunger), SDG 3 (good health and well-being), and SDG 4 (quality education). From 2010 to 2015, the state invested CNY 25.31 billion in rural drinking water, soil, and water conservation and water conservancy construction in pastoral areas; solved the drinking water safety problems of 4.57 million farmers and herdsmen; and effectively supported rural drinking water, water and soil conservation, and pastoral water conservancy construction (SDG 6.4) [51]. Various ecological policies have synergies and effectively address other SDGs, including SDG 8 (decent work and economic growth), SDG 11 (sustainable cities and communities), and SDG 13 (climate action) [52]. The implementation of ecological policies has greatly supported herders' feeding and breeding, alleviating the pressure of overgrazing on grasslands. At the same time, pastoralist incomes, health care, education, consumer spending, and overall welfare have improved. For example, the completion rate of nine-year compulsory education in the QTP has reached more than 90%, and life expectancy has increased from 35 years in the 1950s to more than 70 years now [53].

QTP's social economy is underdeveloped, and social resources such as transportation, education, and science are seriously lagging behind those in coastal areas. Compared with other regions, the human–land relationship and geographical relationship in the QTP are more sensitive and complex, and they have the particularity, difficulty, and necessity of sustainable development in terms of topography, landform, resource endowment, geographical environment, history and culture, and regional development. At present, the sustainable development level of the QTP is in its infancy, and the need to explore ecological policies is essential to ensure the ecological protection and human welfare of the QTP, and to promote the realization of the all-round SDGs.

4.2. Mitigate Climate Change Impact and Improve Disaster Prevention and Mitigation

The ecology of the QTP is fragile and difficult to recover once damaged. At the same time, the QTP has a single industry structure and an underdeveloped social economy level; is lagging behind in transportation, education, and science and technology, and lacks the ability to cope with climate change. The intensity and persistence of global warming are becoming increasingly significant, and the scope and extent of this warming has been increasing (SDG 13). In particular, the frequency, scope, and intensity of disasters, such as climatic disasters, cryosphere disasters, and geological disasters, have followed an increasing trend. The distribution of these disasters is wide and the damage is significant. Natural disasters follow frequent, clustered, and concurrent trends, and their impacts have become an important issue facing sustainable economic and social development [54].

Natural disasters are the result of the joint action of nature and the social environment, and the natural risks of the disaster body are difficult to overcome. Improvements in risk management and the control of a disaster-bearing area, however, could reduce and prevent the occurrence of future disasters. Therefore, it is essential to apply the concept of whole-process risk management and control to the risk management of multi-hazard natural disasters in the QTP, and to enhance the ability of early warning and forecasting, disaster prevention, and mitigation of these disasters. Along with addressing risks, always being prepared for danger in times of peace, preventing problems, and implementing a whole-process control and prevention system of disaster risks are the basic starting points of risk management and control of multi-hazard natural disasters.

The guiding ideology should focus on being "people-oriented", putting "prevention first, combination of avoidance and governance", pursuing "source control" and "whole-process management" and "highlighting key points, step-by-step implementation, and gradual advancement" through a combination of non-engineering and engineering measures (SDG 9), government leadership, and public participation. A comprehensive natural disaster risk management and control system is needed to integrate "disaster early warning and prediction, risk management, disaster prevention and reduction, group testing and mass prevention, emergency relief and post-disaster recovery and reconstruction". This system should be established and improved gradually using the methods of "risk prevention, risk transfer, risk taking and risk avoidance". At the same time, it is necessary to analyze the causes and mechanisms of various disasters, strengthen community publicity and popularization of basic knowledge of disaster prevention and mitigation, allow community residents to know the risk of disaster information, enhance awareness of disaster prevention and avoidance, improve disaster reduction and self-protection capabilities, improve the comprehensive disaster prevention and mitigation capabilities of natural disaster-bearing areas, minimize or avoid potential disaster losses, improve the level of disaster prevention and mitigation in cities and communities, and promote sustainable economic and social development (SDG 11).

5. Three Pole Region Linkage and Multilateral Cooperation for Sustainable Development

The earth has entered the era of the Anthropocene [55], which is characterized by human behavior as the main driving force on a planetary scale [56], causing dynamic changes such as climate warming, biological crisis, and sea-level rise [57]. The TPR has a relatively single ecosystem, excellent environment, a low level of human activities, and a relatively low level of sustainable development. The TPR will have an irreversible impact on the global climate system through climate tipping point elements, in particular on the achievement of polar and global SDGs through remote coupling [58–60]. Currently, popular research directions related to the polar amplification effect and its driving mechanism [61], altitude gradient effect of warming [62], climate change and vegetation response [63], permafrost carbon and global climate effect [64], ozone hole and climate interaction [65–67], and the Arctic and Antarctic climate link [68] have received extensive attention from the academic community.

The TPR is closely related to the climate system and its impacts, and it is essential to consider them as a whole when conducting intensive research [69]. At present, the two difficulties or shortcomings in the research of sustainable development in the TPR are (1) the insufficient monitoring of data [4] and lack of an international data-sharing platform [70], and (2) the lack of international big science research plans. To a certain extent, this has affected the research process of polar sustainable development. Among them, population, economy, climate, disaster, cryosphere and other data are the basis of sustainable development research. To this end, countries in or outside the TPR should strengthen cooperation, strengthen the monitoring of environmental change, increase the monitoring elements and their data, and develop and establish a "Three Pole Regions international data platform" [71] based on an original international database [72]. Improving the capacity of multisource data preparation and promoting the use of a shared data platform can serve the multidimensional and multiscale data required for the collaborative research of environmental change and sustainable development of the TPR [73,74]. At the same time, it is necessary to establish an international TPR big science plan, drawing on the wisdom of scientists from many countries and fields, to scientifically understand the most pressing and difficult issues affecting climate change and sustainable development from a global perspective [75]. In so doing, this effort can reveal the role and influence mechanism of the TPR in the climate system, ecosystem, marine system, and human system. The implementation of these international data platforms and international big science programs will effectively reduce the effect of Liebig's barrel on the polar regions in achieving the SDGs [73] (Figure 1).

The Arctic and Antarctic is a new frontier that has a significant impact on sustainable development and human survival. It also represents the strategic commanding height of competition between the interests and influence of major powers. International cooperation oriented toward "a human community with a shared future" is an effective pathway to conduct research and governance in the Arctic and Antarctic, and this pathway illustrates the contribution of Chinese wisdom to humankind's peaceful use of the polar region [76]. As far as the Arctic and Antarctic are concerned, it is necessary to strengthen international multilateral scientific research as well as political, diplomatic, economic, legal, cultural, and social cooperation research to provide support for the formulation of relevant international, national, and regional policies and promote the polar SDGs. Similarly, the influence and role of the QTP on a global scale also require systematic international multilateral cooperation (Figure 1). Three polar linkage and multilateral cooperation are effective ways to promote the sustainable development of these three poles.

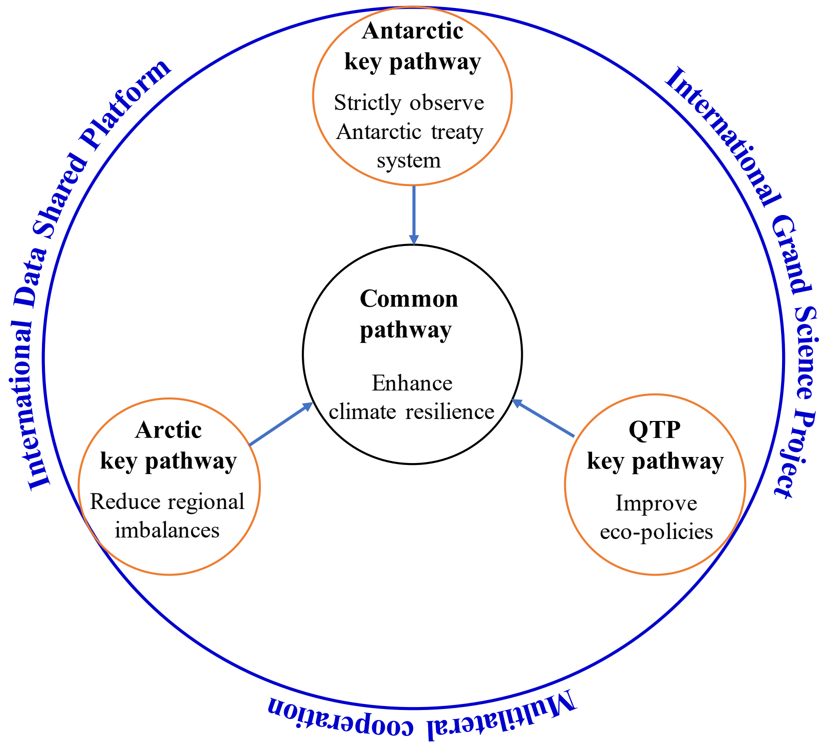

Figure 1. Key pathways to achieving the SDGs in the TPR.

6. Conclusions

The TPR is the focus of countries around the world, and its unique geographic location and resources and environmental effects have made it a significant region in response to global climate change, economic and trade ties, and sustainable development. Sustainable development is essential to the peaceful utilization of the TPR. Both common and different pathways can be followed to achieve the SDGs. The cascading effect of polar climate tipping points have shown that climate action or climate resilience (SDG 13) and enhancement [8] is one such common pathway. Strictly abiding to the Antarctic Treaty and establishing an equal international partnership of sharing, construction, and cogovernance is the key pathway to achieving the Antarctic SDGs. Effectively addressing domestic development imbalances is the key pathway to achieving Arctic SDGs. Using ecological policies to promote ecological protection and people's welfare is the key pathway to achieving the QTP's SDGs. TPR linkage and multilateral cooperation can effectively promote the sustainable development process in scientific research, economy and trade, and culture and tourism.

The TPR's SDGs and their pathways are clear. In the future, they should focus on establishing sound international multilateral cooperation relations or mechanisms to jointly promote the healthy, sustainable development and peaceful use of the TPR. The TPR's climate is sensitive, the ecology is fragile, and the risk of resource exploitation is great. Future sustainable development should be guided by the ATS and the relevant environmental protection system of the Arctic and QTP, with environmental protection as the mainstay and appropriate resource development as a supplement. Among them, Antarctic military use should be prohibited and the red line (i.e., Lineline of warning) of environmental protection and peaceful use should be strictly followed and respected.

In particular, The TPR's SDGs do not exist in isolation, but are closely linked to other regions or even the global scale. It is therefore recommended that all countries strictly abide by and implement the Paris Agreement in order to promote global climate action (climate change mitigation) for achieving the TPR's SDGs.

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References

1. Armstrong McKay, D.I.; Staal, A.; Abrams, J.F.; Winkelmann, R.; Sakschewski, B.; Loriani, S.; Fetzer, I.; Cornell, S.E.; Rockström, J.; Lenton, T.M. Exceeding 1.5 °C global warming could trigger multiple climate tipping points. *Science* **2022**, *377*, eabn7950. [CrossRef] [PubMed]
2. Xiao, C.D.; Wang, X.M.; Su, B. Key Viewpoint of Cryospheric Human-sociology: Function and Service. *Bull. Chin. Acad. Sci.* **2020**, *35*, 504–513. (In Chinese)
3. Brundtland, G.H. *Our Common Future—The Report of the World Commission on Environment and Development*; Oxford University Press: Oxford, UK, 1987.
4. Yang, X.C. *Research on Urban Industrial Energy-Water-Carbon Coupling Analysis Framework and Application Based on Different Perspectives*; Shandong University: Jinan, China, 2019. (In Chinese)
5. Neumann, B.; Vafeidis, A.T.; Zimmermann, J.; Nicholls, R.J. Future coastal population growth and exposure to sea-level rise and coastal flooding—A global assessment. *PLoS ONE* **2015**, *10*, e0118571. [CrossRef]
6. Chen, L.L.; Kong, J.; Deng, S.H. Analysis on overview and hot spots of polar science based on bibliometrics. *Chin. J. Polar Res.* **2021**, *33*, 294–306. (In Chinese)
7. Yan, G.J. An Interpretation of China's Arctic Policy. *Pac. J.* **2018**, *26*, 1–11. (In Chinese)
8. Yao, T.D. TPE international program: A program for coping with major future environmental challenges of The Third Pole region. *Prog. Geogr.* **2014**, *33*, 884–892. (In Chinese)
9. Tandong, Y.; Fahu, C.; Peng, C.; Yaoming, M.; Baiqing, X.; Liping, Z.; Fan, Z.; Weicai, W.; Likun, A.; Xiaoxin, Y. From Tibetan Plateau to Third Pole and Pan-Third Pole. *Bull. Chin. Acad. Sci.* **2017**, *9*, 924–931. (In Chinese)
10. Nagyova, I.; McKee, M.; Droogers, M. Achieving the SDGs in the European Region. *Eur. J. Public Health* **2020**, *30*, i1–i2. [CrossRef]
11. Zhu, J.; Zhai, Y.; Feng, S.; Tan, Y.; Wei, W. Trade-offs and synergies among air-pollution-related SDGs as well as interactions between air-pollution-related SDGs and other SDGs. *J. Clean. Prod.* **2022**, *331*, 129890. [CrossRef]
12. Sköld, P.; Baer, K.C.; Scheepstra, A.; Latola, K.; Biebow, N.; Sköld, P. The SDGs and the Arctic: The need for polar indicators. *Arct. Obs. Summit* **2018**, *2018*, 4–23.
13. Li, C.Y.; Wang, X.M.; Ding, Y.J.; Wei, Z. A study on sustainable use of cryospheric resources. *Clim. Change Res.* **2020**, *16*, 570–578. (In Chinese)
14. Zhang, J.; Zhang, W.; Liu, S.; Kong, W.; Zhang, W. Cryosphere services to advance the national SDG priorities in Himalaya-Karakoram region. *Sustainability* **2022**, *14*, 2532. [CrossRef]
15. Wehi, P.M.; van Uitregt, V.; Scott, N.J.; Gillies, T.; Beckwith, J.; Rodgers, R.P.; Watene, K. Transforming Antarctic management and policy with an Indigenous Māori lens. *Nat. Ecol. Evol.* **2021**, *5*, 1055–1059. [CrossRef]
16. Shijin, W.; Yaqiong, M.; Xueyan, Z.; Jia, X. Polar tourism and environment change: Opportunity, impact and adaptation. *Polar Sci.* **2020**, *25*, 100544. [CrossRef]
17. Levin, L.A.; Le Bris, N. The deep ocean under climate change. *Science* **2015**, *350*, 766–768. [CrossRef]
18. Crespo, G.O.; Dunn, D.C.; Gianni, M.; Gjerde, K.; Wright, G.; Halpin, P.N. High-seas fish biodiversity is slipping through the governance net. *Nat. Ecol. Evol.* **2019**, *3*, 1273–1276. [CrossRef]
19. Kroodsma, D.A.; Mayorga, J.; Hochberg, T.; Miller, N.A.; Boerder, K.; Ferretti, F.; Wilson, A.; Bergman, B.; White, T.D.; Block, B.A.; et al. Tracking the global footprint of fisheries. *Science* **2018**, *359*, 904–908. [CrossRef]
20. Li, X.; Cai, W.; Meehl, G.A.; Chen, D.; Yuan, X.; Raphael, M.; Holland, D.M.; Ding, Q.; Fogt, R.L.; Markle, B.R.; et al. Tropical teleconnection impacts on Antarctic climate changes. *Nat. Rev. Earth Environ.* **2021**, *2*, 680–698. [CrossRef]
21. Ostrom, E. Polycentric systems for coping with collective action and global environmental change. *Glob. Justice. Routledge* **2017**, 423–430.
22. Ramage, J.; Jungsberg, L.; Wang, S.; Westermann, S.; Lantuit, H.; Heleniak, T. Population living on permafrost in the Arctic. *Popul. Environ.* **2021**, *43*, 22–38. [CrossRef]

23. Bohlmann, U.M.; Koller, V.F. ESA and the Arctic-The European Space Agency's contributions to a sustainable Arctic. *Acta Astronaut.* **2020**, *176*, 33–39. [CrossRef]
24. Xiao, C.; Su, B.; Wang, X.; Qin, D. Cascading risks to the deterioration in cryospheric functions and services. *Chin. Sci. Bull.* **2019**, *64*, 1975–1984.
25. Degai, T.S.; Petrov, A.N. Rethinking Arctic sustainable development agenda through indigenizing UN sustainable development goals. *Int. J. Sustain. Dev. World Ecol.* **2021**, *28*, 518–523. [CrossRef]
26. Li, Z.F.; Li, X.T. Topic structure and development trend of domestic seminars on Arctic research. *J. Ocean. Univ. Chin.* **2022**, 69–79. (In Chinese)
27. Ramanathan, V.; Xu, Y.; Versaci, A. Modelling human–natural systems interactions with implications for twenty-first-century warming. *Nat. Sustain.* **2022**, *5*, 263–271. [CrossRef]
28. Yu, H.Y. Climate Change and the Evolution of Geopolitics and Geoeconomics in the Arctic region. *J. Int. Stud.* **2015**, *36*, 73–87. (In Chinese)
29. Xia, L.P.; Wang, C.X.; Su, P.; Tang, Y.; Pan, M. *Research on Arctic Governance and Development*; World Knowledge Publishing House: Beijing, China, 2020. (In Chinese)
30. Yang, J.; Zheng, Y.Q. Global Governance of New Frontiers: China's Perspective. *Chin. Int. Stud.* **2017**, *66*, 24–44.
31. Ding, H. *Polar Governance and China's Participation*; Science Press: Beijing, China, 2018. (In Chinese)
32. Fang, M.; Li, X.; Chen, H.W.; Chen, D. Arctic amplification modulated by Atlantic Multidecadal Oscillation and greenhouse forcing on multidecadal to century scales. *Nat. Commun.* **2022**, *13*, 1865. [CrossRef]
33. Forster, C.E.; Norcross, B.L.; Spies, I. Documenting growth parameters and age in Arctic fish species in the Chukchi and Beaufort seas. *Deep. Sea Res. Part II Top. Stud. Oceanogr.* **2020**, *177*, 104779. [CrossRef]
34. Box, J.E.; Colgan, W.T.; Christensen, T.R.; Schmidt, N.M.; Lund, M.; Parmentier, F.-J.W.; Brown, R.; Bhatt, U.S.; Euskirchen, E.S.; Romanovsky, V.E.; et al. Key indicators of Arctic climate change: 1971–2017. *Environ. Res. Lett.* **2019**, *14*, 045010. [CrossRef]
35. Yao, Y.; Luo, D.; Dai, A.; Simmonds, I. Increased quasi stationarity and persistence of winter Ural blocking and Eurasian extreme cold events in response to Arctic warming. Part I: Insights from observational analyses. *J. Clim.* **2017**, *30*, 3549–3568. [CrossRef]
36. Biskaborn, B.K.; Smith, S.L.; Noetzli, J.; Matthes, H.; Vieira, G.; Streletskiy, D.A.; Schoeneich, P.; Romanovsky, V.E.; Lewkowicz, A.G.; Abramov, A.; et al. Permafrost is warming at a global scale. *Nat. Commun.* **2019**, *10*, 264. [CrossRef] [PubMed]
37. Ford, J.D.; King, N.; Galappaththi, E.K.; Pearce, T.; McDowell, G.; Harper, S.L. The resilience of indigenous peoples to environmental change. *One Earth* **2020**, *2*, 532–543. [CrossRef]
38. Hjort, J.; Streletskiy, D.; Doré, G.; Wu, Q.; Bjella, K.; Luoto, M. Impacts of permafrost degradation on infrastructure. *Nat. Rev. Earth Environ.* **2022**, *3*, 24–38. [CrossRef]
39. Cook, D.; Malinauskaite, L.; Davíðsdóttir, B.; Ögmundardóttir, H. Co-production processes underpinning the ecosystem services of glaciers and adaptive management in the era of climate change. *Ecosyst. Serv.* **2021**, *50*, 101342. [CrossRef]
40. Yletyinen, J. Arctic climate resilience. *Nat. Clim. Change* **2019**, *9*, 805–806. [CrossRef]
41. Pongrácz, E.; Victor, P.; Niko, H. *Arctic Marine Sustainability: Arctic Maritime Businesses and the Resilience of the Marine Environment*; Springer: Berlin/Heidelberg, Germany, 2020.
42. Folke, C.; Carpenter, S.R.; Walker, B.; Scheffer, M.; Chapin, T.; Rockström, J. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecol. Soc.* **2010**, *15*, 20. [CrossRef]
43. Pörtner, H.-O.; Roberts, D.C.; Adams, H.; Adler, C.; Aldunce, P.; Ali, E.; Begum, R.A.; Betts, R.; Kerr, R.B.; Biesbroek, R.; et al. Climate Change 2022: Impacts, Adaptation, and Vulnerability. In *Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2022.
44. Guo, H.; Chen, F.; Sun, Z.; Liu, J.; Liang, D. Big Earth Data: A practice of sustainability science to achieve the Sustainable Development Goals. *Sci. Bull.* **2021**, *66*, 1050–1053. [CrossRef]
45. Zhang, F.; Thapa, S.; Immerzeel, W.; Zhang, H.; Lutz, A. Water availability on the Third Pole: A review. *Water Secur.* **2019**, *7*, 100033. [CrossRef]
46. Wang, L.; Yao, T.; Chai, C.; Cuo, L.; Su, F.; Zhang, F.; Yao, Z.; Zhang, Y.; Li, X.; Qi, J.; et al. TP-River: Monitoring and quantifying total river runoff from the Third Pole. *Bull. Am. Meteorol. Soc.* **2021**, *102*, E948–E965. [CrossRef]
47. Wang, T.; Yang, D.; Yang, Y.; Piao, S.; Li, X.; Cheng, G.; Fu, B. Permafrost thawing puts the frozen carbon at risk over the Tibetan Plateau. *Sci. Adv.* **2020**, *6*, eaaz3513. [CrossRef] [PubMed]
48. Lenton, T.M.; Rockström, J.; Gaffney, O.; Rahmstorf, S.; Richardson, K.; Steffen, W.; Schellnhuber, H.J. Climate Tipping Points—Too Risky to Bet Against. *Nature* **2019**, *575*, 592–595. [CrossRef] [PubMed]
49. Tavoni, A.; Levin, S. Managing the climate commons at the nexus of ecology, behavior and economics. *Nat. Clim. Change* **2014**, *4*, 1057–1063. [CrossRef]
50. Talukder, B.; Matthew, R.; Bunch, M.J.; Hipel, K.W.; Orbinski, J. Melting of Himalayan glaciers and planetary health. *Curr. Opin. Environ. Sustain.* **2021**, *50*, 98–108. [CrossRef]
51. Xu, Z.; Chau, S.N.; Chen, X.; Zhang, J.; Li, Y.; Dietz, T.; Wang, J.; Winkler, J.A.; Fan, F.; Huang, B.; et al. Assessing progress towards sustainable development over space and time. *Nature* **2020**, *577*, 74–78. [CrossRef] [PubMed]
52. Wang, S.J.; Wei, Y.Q. Qinghai-Tibetan Plateau Greening and Human Well-Being Improving: The Role of Ecological Policies. *Sustainability* **2022**, *14*, 1652. [CrossRef]

53. Wang, S.J.; Wei, Y.Q.; Niu, C.H.; Zhang, Y.F. Comprehensive Risk Assessment and Control of Multiple Natural Disasters in Qinghai-Tibet Platea. *J. Glaciol. Geocryol.* **2022**, *43*, 1708–1720. (In Chinese)
54. Lewis, S.L.; Maslin, M.A. Defining the anthropocene. *Nature* **2015**, *519*, 171–180. [CrossRef]
55. Boivin, N.; Crowther, A. Mobilizing the past to shape a better Anthropocene. *Nat. Ecol. Evol.* **2021**, *5*, 273–284. [CrossRef]
56. Barrett, S. Choices in the climate commons. *Science* **2018**, *362*, 1217. [CrossRef]
57. Guo, H.; Li, X.; Qiu, Y. Comparison of global change at the Earth's three poles using spaceborne Earth observation. *Sci. Bull.* **2020**, *65*, 1320–1323. [CrossRef]
58. Yao, T.; Bolch, T.; Chen, D.; Gao, J.; Immerzeel, W.; Piao, S.; Su, F.; Thompson, L.; Wada, Y.; Wang, L.; et al. The imbalance of the Asian water tower. *Nat. Rev. Earth Environ.* **2022**, *3*, 618–632. [CrossRef]
59. Xie, Y.; Wu, G.; Liu, Y.; Huang, J.; Nie, H. A dynamic and thermodynamic coupling view of the linkages between Eurasian cooling and Arctic warming. *Clim. Dyn.* **2022**, *58*, 2725–2744. [CrossRef]
60. Zhisheng, A.; Guoxiong, W.; Jianping, L.; Youbin, S.; Yimin, L.; Weijian, Z.; Yanjun, C.; Anmin, D.; Li, L.; Jiangyu, M.; et al. Global monsoon dynamics and climate change. *Annu. Rev. Earth Planet. Sci.* **2014**, *42*, 29–77. [CrossRef]
61. Pepin, N.; Bradley, R.S.; Diaz, H.F.; Baraer, M.; Caceres, E.B.; Forsythe, N.; Fowler, H.; Greenwood, G.; Hashmi, M.Z.; Liu, X.D.; et al. Elevation-dependent warming in mountain regions of the world. *Nat. Clim. Change* **2015**, *5*, 424–430.
62. Wu, W.; Sun, X.; Epstein, H.; Xu, X.; Li, X. Spatial heterogeneity of climate variation and vegetation response for Arctic and high-elevation regions from 2001–2018. *Environ. Res. Commun.* **2020**, *2*, 011007. [CrossRef]
63. Wang, X.; Ran, Y.; Pang, G.; Chen, D.; Su, B.; Chen, R.; Li, X.; Chen, H.W.; Yang, M.; Gou, X.; et al. Contrasting characteristics, changes, and linkages of permafrost between the Arctic and the Third Pole. *Earth-Sci. Rev.* **2022**, *230*, 104042. [CrossRef]
64. Shindell, D.T.; Schmidt, G.A. Southern Hemisphere climate response to ozone changes and greenhouse gas increases. *Geophys. Res. Lett.* **2004**, *31*, L18209. [CrossRef]
65. Wang, Z.; Zhang, X.; Guan, Z.; Sun, B.; Yang, X.; Liu, C. An atmospheric origin of the multi-decadal bipolar seesaw. *Sci. Rep.* **2015**, *5*, srep08909. [CrossRef]
66. Safieddine, S.; Bouillon, M.; Paracho, A.; Jumelet, J.; Tencé, F.; Pazmino, A.; Goutail, F.; Wespes, C.; Bekki, S.; Boynard, A.; et al. Antarctic ozone enhancement during the 2019 sudden stratospheric warming event. *Geophys. Res. Lett.* **2020**, *47*, e2020GL087810. [CrossRef]
67. Gao, K.; Duan, A.; Chen, D.; Wu, G. Surface energy budget diagnosis reveals possible mechanism for the different warming rate among Earth's three poles in recent decades. *Sci. Bull.* **2019**, *64*, 1140–1143. [CrossRef]
68. Wilkinson, M.D.; Dumontier, M.; Aalbersberg, I.J.; Appleton, G.; Axton, M.; Baak, A.; Blomberg, N.; Boiten, J.W.; da Silva Santos, L.B.; Bourne, P.E.; et al. The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* **2016**, *3*, 160018. [CrossRef] [PubMed]
69. Lin, D.; Crabtree, J.; Dillo, I.; Downs, R.R.; Edmunds, R.; Giaretta, D.; De Giusti, M.; L'Hours, H.; Hugo, W.; Jenkyns, R.; et al. The TRUST Principles for digital repositories. *Sci. Data* **2020**, *7*, 144. [CrossRef]
70. Pertierra, L.; Santos-Martin, F.; Hughes, K.; Avila, C.; Caceres, J.; De Filippo, D.; Gonzalez, S.; Grant, S.; Lynch, H.; Marina-Montes, C.; et al. Ecosystem services in Antarctica: Global assessment of the current state, future challenges and managing opportunities. *Ecosyst. Serv.* **2021**, *49*, 101299. [CrossRef]
71. Carroll, S.R.; Herczog, E.; Hudson, M.; Russell, K.; Stall, S. Operationalizing the CARE and FAIR Principles for Indigenous data futures. *Sci. Data* **2021**, *8*, 108. [CrossRef]
72. Li, X.; Cheng, G.; Wang, L.; Wang, J.; Ran, Y.; Che, T.; Li, G.; He, H.; Zhang, Q.; Jiang, X.; et al. Boosting geoscience data sharing in China. *Nat. Geosci.* **2021**, *14*, 541–542. [CrossRef]
73. Hung, C.L.; Sun, Z.C.; Jiang, H.P.; Wang, J.; Wang, P.; Tao, J.; Liu, H.; Liu, N. Big Earth Data Supports Sustainable Cities and Communities: Progress and Challenges. *Bull. Chin. Acad. Sci.* **2021**, *36*, 914–922. (In Chinese)
74. Yang, J. Strategic Thinking on the Development of China's Polar Cause. *Renming Luntan·Xueshu Qianyan* **2017**, *11*, 6–15. (In Chinese)
75. Rockström, J.; Steffen, W.; Noone, K.; Persson, Å.; Chapin, F.S.; Lambin, E.F.; Lenton, T.M.; Scheffer, M.; Folke, C.; Schellnhuber, H.J.; et al. A safe operating space for humanity. *Nature* **2009**, *461*, 472–475. [CrossRef]
76. Wester, P.; Mishra, A.; Mukherji, A.; Shrestha, A.B. *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*; Springer Nature, Switzerland AG: Cham, Switzerland, 2019.