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SUSTAINABLE DEVELOPMENT IN OUTER SPACE- APPLICABILITY OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT TO SPACE DEBRIS PROBLEMS

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[Abstract] Legal regulation of space debris is a difficult problem since it is a political issue. This paper seeks to prepare for future discussions of the legal framework for space debris regulation and to search for applicable principles. Since the space debris problem has aspect similar to environmental protection of outer space, principles and concepts arising out of international environmental law must be applied to solve it. This paper will present realistic and useful principles for the future legal framework for space debris regulation, namely Article IX of the Outer Space Treaty, as a general principle for protecting the outer space environment, as well as the concept of sustainable development as implementing guidelines for it.

I. Introduction

Recently, space debris has become a severe problem for space activities because of its sheer volume and because it sometimes collides with operating space systems or even crashes to the ground. Even tiny pieces can cause severe damage to space systems because they are revolving around the Earth at high speeds. Therefore, space debris threatens today's space activities, especially manned space activities such as the international space station.

Nowadays, there are discussions to limit or mitigate the space debris problem not only in scientific and technological fields but also in the legal field. However, it appears to be difficult to establish a strong legal framework to limit space debris in the near future because it is a highly political issue that can raise the cost of space activities and thus negatively impact the space industry. Nevertheless, there has been a slow but considerable movement to solve this issue at the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS).

This paper is based on the understanding that, if certain legal instruments are to be developed for space debris problems, an environmental viewpoint is required because space debris is an environmental problem of outer space.

At the same time, this paper attempts to link the space debris problems to the concept of "sustainable development", which is a

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trend in environmental law. Since the efforts to solve the space debris problem contribute to the "sustainable use of outer space" by balancing environmental protection and economic development, the concept of sustainable development appears to be applicable to this issue. However, such linkage is not found in the relevant documents for space activities.[1]

This paper will examine the applicability of the concept of sustainable development to the space debris problems. For this purpose, the current situation of the space debris problems and applicable existing legal documents to the space debris problem will first be reviewed.

II. Current situation of the space debris problems

(1) Various origins of space debris

The major origins of space debris are inactive satellites or payloads and spent stages of rockets and parts thereof. While the precise definition of space debris is still controversial, the International Law Association provided five origins of space debris in its Draft Convention on Space Debris in 1994.[2] The Scientific and Technical Subcommittee of the UNCOPUOS also defined space debris in its technical report on space debris.[3]

In 1995, the estimated space debris population more than 1mm exceeded 35 million pieces and is increasing rapidly.[4] Most pieces are smaller than 1 cm and thus can not be monitored. However, even such small debris has enough energy to partially damage operative satellites. The US Command monitors more than eight thousand pieces of space debris that exceed 10 cm and can totally destroy satellites in case of crash, although such pieces represent only 0.02% of the whole.

It is estimated that the risk of a collision with space debris is not crucial at this moment. However, further increases of space debris, especially in the Geostationary Earth Orbit (GEO), would create serious problems because there is no natural force to remove it.

(2) Measures against space debris

In order to protect large space objects such as the international space station, monitoring of space debris is very important to avoid damage caused by them. The USA and Russia have developed adequate technologies to monitor space debris over 10cm in diameter. Therefore collisions with such large space debris can be avoided by maneuvering operative satellites out of harms way. In addition, bumpers can be useful for space debris smaller than 1cm. However, it is difficult to avoid damage caused by space debris between 1cm and 10cm.

Recently, fuel remaining after a mission is often vent in order to avoid explosion of spent satellites or rocket stages. Furthermore, spent satellites are often removed from the useful orbit regions, especially to achieve

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[1] Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, A/CONF.184/6,pp.1-4 mentions the idea of sustainable development but merely from the viewpoint of using space technology for the sustainable development of countries.

[2] Routine space operations including spent stage of rockets and space vehicles, and hardware released during normal maneuvers; orbital explosions and satellite breakups, whether intentional or accidental; collision-generated debris; particles and other forms of pollution ejected such as by solid rocket exhaust; abandoned satellites.

[3] It provides that space debris are all man-made objects, including their fragments and parts, whether their owners can be identified or not, in Earth orbit or re-entering the dense layers of the atmosphere that are non-functional with no reasonable expectation of their being able to assume or resume their intended functions or any other functions for which they are or can be authorized., A/AC,105/672.

[4] The National Science and Technology Council, Committee on Transportation Research and Development (USA), Interagency Report on Orbital Debris 1995, p.6.

effective use of GEOs. Many space agencies are also trying to design their satellites to minimize space debris, but it is difficult for them to design satellites that do not generate any space debris with today's technology.

Governmental space agencies in most space-faring countries are exchanging views and information in a forum named the Inter-Agency Space Debris Coordination Committee (IADC). Based on the discussions there, several governmental agencies, such as NASA (USA), NASDA (Japan), CNES (France) and RSA (Russia), have set internal standards to mitigate space debris. The IADC is now trying to establish a common standard for space debris mitigation, which is to be finalized within several years.

The technical report on space debris adopted by the Scientific and Technical subcommittee of the UNCOPUOS in 1999[5] consisted of space debris measurement, modeling and mitigation measures through the cooperation of member States, although it is not legally binding.

III. Existing space treaties applicable to space debris problems

There are opinions insisting that the several obligations in existing space treaties and relative documents listed below should apply to the space debris problems.[6]

(1) Protection of the environment of outer space

Paragraph 2 of Article IX of the Outer Space Treaty spells out general protection of the space environment. It provides that States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their *harmful contamination* and *adverse changes* in the Earth's environment resulting from the introduction of extraterrestrial matter and, where necessary, *shall adopt appropriate measures* for this purpose. Some authors point out that "harmful contamination" may include space debris and "adverse changes" may include re-entry and crash of space debris into the ground, therefore "appropriate measures [to be adopted by State Parties]" may include measures to reduce space debris.

Article 7 of the Moon Agreement of 1979 provides protection of the Moon environment, therefore some authors point out that it may be applicable to space debris on or near the Moon, although most space faring states have not ratified it.

(2) Obligatory reporting of information

Paragraph 3 of Article V of the Outer Space Treaty provides that State Parties to the Treaty shall immediately inform the other States and the UN Secretary-General of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts. Some authors insist that this paragraph covers information about space debris.

Paragraph 3 of Article 4 of the Registration Convention of 1976 also established the obligation of the launching states to give information on space objects, including components of space objects, their launch vehicles and parts thereof, that it has previously transmitted when these objects are no longer in Earth orbit. Some authors hold that this provision applies to information about space debris.

(3) Liability for damage caused by space debris

Article VII of the Outer Space Treaty provides the principles of international liability for damage caused by space objects or *their component parts* on the Earth, in the air or in outer space; these principles were further elaborated in the Liability Convention. As explicitly stated in Article 1 of the Liability Convention, the term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof.

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[5] ibid. note 3.

[6] Authors' opinions in this chapter are primarily based on V. Kopal, *Present International Law Principles Applicable to Space Debris and the Need for Their Supplement*, Proceedings of the Second European Conference on Space Debris (1997), pp.739-743.

Since most space debris originates from space objects, their launch vehicles or parts thereof, such debris may be covered by this definition.

Based on such understandings, many authors hold that absolute liability provided in Article II of Liability Convention also applies to damage caused by space debris on the surface of the Earth or to aircraft flight and that liability based on fault in Article III would apply to the damage of space objects by space debris.

Since there is no definition of *fault* in the Liability Convention, some authors even insist that causing space debris constitutes *fault* in the context of the Liability Convention.

(4) Damage to the space environment

Some authors point out that there is a possibility that damage to be compensated according to the Liability Convention covers damage caused by space activities to *the space environment itself*, even though the definition of the damage in Article I of the Convention does not include such damage explicitly.

(5) Summary

In spite of these profound opinions, which aspects or provisions of space treaties should apply for space debris problem is highly controversial. This issue has not been discussed in the legal subcommittee of the UNCOPUOS yet because many space-faring countries are reluctant to adopt this issue as its official agenda. They have been insisting that it is premature to start legal studies on space debris because sufficient scientific study should be performed first.

In 1996, the Czech Republic, represented by Prof. V. Kopal of Charles University, presented as an unofficial background note titled "Review of existing norms of international law applicable to space debris" to the legal subcommittee of the UNCOPUOS.[7] This note, which appears to be a summary of discussions in academic fields, contains various profound questions.

However, after intense discussions, the legal subcommittee, which requires unanimous consensus to its decision, decided that the space debris problem should not be included in its current agenda, as a result of strong objections from space- faring countries.

Although the scientific and technical subcommittee of the UNCOPUOS has finalized its three-year study on space debris in 1999, they are still reluctant to start legal discussions on it.

In summary, there is no consensus with regard to the applicability of space treaties to space debris problems since no discussion has started in an appropriate international forum such as the legal subcommittee of the UNCOPUOS. However, in my opinion, it should be possible to form a consensus on the applicability of matters not directly related to the liability issue or raising the cost of space activities, such as general provision for environmental protection of outer space provided in Article IX of Outer Space Treaty.

IV . Existing international environmental law applicable to space debris problems

The general obligation of States not to damage the environment beyond national jurisdictions was established in the famous Trail Smelter Arbitrations and enshrined in two important documents, Principle 21 of the Stockholm Declaration and Principle 2 of the Rio Declaration.[8] They provide that the States have responsibility to ensure activities within their jurisdiction or control do not damage the environment of other States or of *areas beyond the limits of their national jurisdiction*. Although environmental law basically regulates environment protection on the Earth, these provisions appear to cover protection of the outer space environment as well because outer space corresponds to "an area beyond the limits of national

[7] Report of the Legal Subcommittee of 35th session, A/ AC.105/ 637(1996), p.17.

[8] George T. Hacket, Space Debris and the Corpus Iuris Spatials (1994) , pp.138-142.

jurisdiction."

Some authors insist that these principles reflect customary rules of international law. However, it allows counter-arguments that they are not legally binding and do not impose obligations unless they are followed or sustained by sufficient State practice.[9]

In fact, there are no treaties for space activities such as the United Nations Framework Convention on Climate Change in 1992 that crystallize obligations in these declarations. Therefore, at this moment, we have to depend on these two declarations in order to introduce the environmental law viewpoint into the space debris problem, although they do not have strong legally binding powers.

V. Concept of sustainable development

In this Chapter, we will briefly review the basic idea of sustainable development.[10]

The basic idea of sustainable development is to balance environmental protection and economic development. Many treaties contain such an idea. The 1985 ASEAN agreement on the Conservation of Nature and Natural Resources is the first treaty to refer to the concept of sustainable development.

The Stockholm Declaration of 1972 consisting of 26 principles frequently referred to such a balance in its text. The Rio Declaration of 1992, consisting of 27 principles, followed by its implementation plan named Agenda 21 provided a more specific and precise concept than the Stockholm Declaration.

There are four inherent principles and five supporting principles for the concept sustainable development.

(1) Four inherent principles

-Integration of environment and development.
-Application of equity between States.
-Consideration of the needs of future generations.
-Non-exhaustion of renewable natural resources (sustainable use).

(2) Five supporting principles

-State has sovereignty over natural resources and the responsibility not to cause environmental damage.
-Good neighborliness and international cooperation.
- Common but differentiated responsibility.
- Precautionary principle.
- Polluter-pay principle.

VI. Applicability of the concept of sustainable development to space debris problem

In this section, we will examine the applicability of the concept of sustainable development to the space debris problem, which may give us some indication of how to solve it. Although the subject of environmental law today, including the concept of sustainable development, basically concerns the environment on the Earth, we will try to extend it to the environment of outer space. To do so, we will examine the applicability of the nine principles above one by one.

(1) First category: Inherent principles in the concept of sustainable development

(a) Integration of environment and development

Obviously, mitigating space debris in order to maintain the environment of outer space is based on such idea. Measures for mitigating space debris are costly, and therefore could limit the free exploration and use of outer space provided in Article I of the Outer Space Treaty. However, the necessity to mitigate space debris itself is generally recognized today, and many governmental space agencies, which generally oppose the legal regulation of space debris, are actually taking measures to mitigate space debris. Their concern today is how and to what extent space debris should be mitigated.

Therefore, the principle of integration of

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[9] ibid.note 8., pp.142-146

[10] Basic understanding of the concept of sustainable development in this paper is based on the opinion of Philippe Sands, in his material *International Law in the field of sustainable development (1995).*

environment and development can contribute as a principle for solving space debris problems.

(b) Application of equity between States

The movement to mitigate space debris is also based on the idea of equity between states.

Although there is no concrete definition for the equity in the context of sustainable development, in my opinion, it corresponds to the understanding that every State should have the same opportunities, even if some of them can be realized only at a later stage.

States that have not developed space technologies sufficient to exploit and use the outer space are anxious about keeping their rights for these activities in the future. Therefore, they insist on mitigating space debris because if space debris continues to increase, it would hinder their future space activities. This is today's situation in the UNCOPUOS where developing countries are strongly urging developed countries to take measures to mitigate space debris.

Therefore, mitigation of space debris is apparently a reflection of the idea of allocating rights and responsibilities for States with differing levels of economic development and perspectives on their future needs and priorities, and thus is a reflection of the principle of equity.

(c) Consideration of the needs of future generations

Measures taken today to mitigate space debris are no doubt for the benefit of future generations because the present generation must bear additional cost or perhaps give up certain space activities in order to maintain the environment of outer space for future space activities.

(d) Non-exhaustion of renewable natural resources (sustainable use)

Sustainable use of the outer space is apparently the core idea for mitigating space debris. If we do not take action to mitigate space debris right now, the quantity of space debris will continue to increase rapidly, and perhaps we will not be able to use outer space, especially GEOs, efficiently any longer.

(2) Second category of principles: drawn from other areas of international law and intended to provide assistance in achieving sustainable development

(a) Sovereignty over natural resources and the responsibility not to cause environmental damage

This principle is introduced by principle 21 of the Stockholm Declaration and has been modified by Principle 2 of the Rio Declaration. Many authors insist that it reflects a rule of customary international law: achieving a balance between the principle that States have sovereignty over their natural resources and that they must not cause damage to the environment in areas outside their jurisdiction or control.[11]

Since Article I of the Outer Space Treaty provides that the exploration and use of outer space shall be *the province of mankind* and Article II denies the national appropriation of outer space, outer space an area outside the jurisdiction or control of any state. Therefore, although the former part of this principle has nothing to do with space activities, the latter part of this principle can contribute for solving the space debris problem since there is general consensus about the need to maintain the space environment.

(b) Good neighborliness and international cooperation

One of the core ideas for mitigating space debris is that states must carry out their own space activities while paying attention to present and future space activities of other States. Therefore, good neighborliness and international cooperation can be a principle for reducing space debris.

(c) Common but differentiated responsibility

This principle includes two related elements that seek to balance the objective of developing principles and standards of

[11] ibid. note 10. pp.342-343.

universal application while taking account of the different needs and responsibilities of States.[12]

The unique aspect of the space debris problem is that *developed countries* have stronger needs to develop their space activities and *developing countries* insist on protecting the environment of outer space in order to maintain their rights for future space activities. Therefore, with regard to the space debris problem, developed countries are more concerned about development and developing countries are more concerned about the protection of space environment, which is opposite to the normal situation regarding sustainable development

However, it is generally accepted that all states share a common responsibility to protect outer space environment. Therefore, we can say this principle also applies for solving the space debris problem because there is a common responsibility to protect the environment of outer space, and, at the same time, there will be also different responsibilities between developed countries and developing countries since only space-faring countries can take effective measures to solve the space debris problem.

(d) Precautionary principle

Although precaution theoretically applies to the space debris problem, and is a useful principle for mitigating space debris, it could be difficult to reach consensus among States to adopt it as a principle to solve space debris because it directly leads to the limitation of space activities.

An important factor of the precaution approach is to shift the burden of proof from the person (State) wishing to stop an activity (traditional approach) onto the person (State) wishing carry out that activity to show that it will not cause harm (precautionary approach).

It is difficult for third-party countries, especially developing countries, to prove a harmful result of some country's space activities because of a lack of information. In fact, the report by the Science and Technical Subcommittee of the UNCOPUOS on space debris heavily depended on the cooperation by space-faring states. Therefore, it would be desirable for space-faring states to assume the burden of proof that their activities do not cause severe or irreversible damage. However, it will also be difficult to reach consensus on such a shift of burden of proof.

On the other hand, there are activities that could constitute state practices for implementing the precaution principle applied to space debris problems. For example, many governmental space agencies have established internal space debris mitigation standards through the coordination at the IADC including precautionary measures for space debris.

Additionally, Article IX of the Outer Space Treaty provides that states have to undertake international consultations before proceeding with space activities if their activities would cause potentially harmful interference. This may correspond to precaution, though the applicability of this Article to space debris remains uncertain.

In summary, precautionary principle can be applied to the space debris problem, although it is difficult to reach a consensus for adopting it as a legal obligation at this moment.

(e) The Polluter-pays Principle

This principle means that the costs of pollution and its consequences should be borne by the person or persons responsible for it. Recently, this principle has developed into the Extended Producer Responsibility Principle, especially in the field of waste regulations in European Countries.

It is also very difficult to reach a consensus on applying this principle to the space debris problem. Developed countries strongly oppose introducing this principle to the space debris problems because it directly raises the cost of space activities and thus limits the development of the space industry. Another reason for the negative position of developed countries will be that they have not established sufficient technology for

[12] ibid. note 10. pp.344-345.

eradicating space debris.

In contrast, developing countries insist that space-faring countries should bear these costs. Some have even proposed that space-faring states share joint liability for the damage caused by space debris or establishing funds for such damage, since it is very difficult to prove which state caused what space debris.

The Liability Convention introduced absolute liability regarding the damage caused by space objects. The applicability of this principle to space debris problems is closely related to the applicability of this Convention to the space debris problems, which is still controversial and does not appear to reach a consensus in the near future. Although many developing countries insist that the damage caused by space debris is attributable to the state that caused it such as provided in Article 8 of the ILA draft, this argument will not end soon.

(3) Summary

From these observations, we can conclude that all four inherent principles and most of the assisting principles of sustainable development appear to be applicable to the space debris problems without difficulties. This means that the concept of sustainable development could contribute for solving space debris problems, although certain consultation between developed and developing countries is required, especially for the precaution and polluter-pays principles.

Nevertheless, if we take into account the fact that the five documents of UN Conference on Environment and Development (UNCED)[13] lack one or both of these principles, we can say there is a considerable possibility that the concept of sustainable development can be a useful measure for solving space debris problems. This means that the concept of sustainable development is worthwhile as a foundation for certain legal documents for space debris mitigation that should be established *in the future*.

VII. "Sustainable Development" in existing scheme

The observation in the previous section demonstrated the concept of sustainable development is basically applicable to the space debris problem.

In this section, as our final observation, we will examine the hidden concepts of sustainable development in the existing space treaties or related documents.

As we stated above, the applicability of space treaties to the space debris problem is still controversial. However, if there are similar concepts with sustainable development among them, they should also be listed in possible future legal instruments for space debris mitigation, as long as such instruments adopt the concept of sustainable development as one of their basic ideas. Moreover, such hidden concepts in existing schemes can reinforce the applicability of the concept of sustainable development as leading principles already adopted by States, even though they were adopted before the Rio Declaration.

(1) Article IX of the Outer Space Treaty

Several provisions in Article IX of the Outer Space Treaty contain ideas similar to the sustainable development.

Paragraph 1 of Article IX provides for the *due regard* to the corresponding interests of all other States Parties to the Treaty. It is based on the idea of *good neighbors* and *equity* which are the principles of sustainable development.[14]

Paragraph 2 of Article IX provides for the duty to avoid harmful contamination of outer space, including the Moon and other celestial bodies, and adverse changes in the Earth. Since this limits the free exploration and use of outer space as provided in Article I, it seems to be based on the principle of *integration of environment and development*,

[13] Rio Declaration, Agenda 21, Forest Principles, Biodiversity Convention and Climate Change Convention

[14] ibid. note8, pp.99-103.

which is a principle of sustainable development. Furthermore, some authors point out that this sentence provides not merely protection of the outer space environment but also relates to the *rights of future generations*. Other authors hold that it is also based on the responsibility *not to cause damage to the environment of* areas *beyond the limits of national jurisdiction* because outer space is *the province of all mankind* and *not subject to national appropriation.*

Paragraphs 3 and 4 of Article IX provide for consultation before the space activities that would cause potentially harmful interference with activities of other States Parties, which may correspond to *precaution*, one of the principles of sustainable development.

(2) Liability Convention

If space debris could be defined as space objects as provided in Article 1(ii)(d) of the Liability Convention, damage caused by them would be treated according to the Liability Convention. Such disposition of liability appears to be based on the *Polluter-pays principle*. However, whether space debris is a space object or not will be very difficult to establish by consensus since the cost of space activities will rise if the Liability Convention is fully applied to space debris.

(3) Vienna Declaration by UNISPACE III of 1999

UNISPACE III adopted a non-legally-binding document titled the "Vienna Declaration on Space and Human Development." [15] This declaration clearly stated that "sustainable development" applies to space activities in several Articles.[16] It defined space technologies as unprecedented challenges to *sustainable development*. It also provided that results of space research should assist States, especially developing countries, with a view to promoting *sustainable development* of all people.

These articles provide for space technology as measures for sustainable development of countries. However, they do not identify the concept of sustainable development as a concept for the sustainable use of outer space, in other words, in order to protect the space environment from space debris. Therefore, there are no hidden concepts of sustainable development in the Vienna Declaration in the context of this paper.

(4) ILA Draft Convention on Space Debris of 1994

The ILA Draft Convention on Space Debris of 1994, the first concrete proposal for a legal instrument on space debris, contains a significant implication on the future framework for the legal regulation of space debris, although it is merely an academic study. It defines space debris and declares that damage in the context of this Draft Convention includes damage to the environment. It further provides that states are liable for damage *as a consequence of* space debris created by their space activities, which may be related to the polluter-pays principle. It also contains measures which may be based on the *precaution principle* such as consultations.

On the other hand, it includes no explicit mention to the "sustainable development", although it was developed after the Rio Declaration.

(5) Summary

It will be difficult to reach a consensus on the polluter-pays principle while decisions by the UNCOPUOS are based on consensus. Therefore, Article IX of Outer Space Treaty would be the realistic answer for the examination in this Chapter concerning available provisions relating to the concept of sustainable development to be listed in the possible future legal instrument. Although

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[15] Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, A/CONF.184/6,pp.1-4.

[16] ibid. note 15., Preamble paragraph 11 & 13, Article 1.(b)(vi), Article3, Chapter II paragraph 3.

the provisions of this Article are general, they may relate to various principles of sustainable development.

Therefore, we may say that the concept of sustainable development can collaborate with Article IX of the Outer Space Treaty in order to develop certain legal instruments in the future. In other words, the principles of sustainable development can be considered as the implementing guidelines for Article IX of the Outer Space Treaty.

VIII. Conclusion

In my observation, certain legal instruments such as a declaration could be developed in the UNCOPUOS in the future. Scientific study for this has already been done, and developed countries are facing more difficulties in finding persuasive excuses to extend the legal study of space debris any longer, which is similar to the situation of the UNCED negotiation [17]. Therefore now is the time to prepare to discuss on adequate principles for space debris.

Since space debris problems have the aspect of environmental problems in outer space, we must apply the principles and concepts arising out of environmental law to solve them, although we have to modify them since they originally developed for protecting the Earth environment.

Since space debris is a politically difficult problem, it would be difficult to directly regulate it by applying existing space treaties, especially the Liability Convention. Therefore, a possible future legal instrument could be a non-legally binding document consisting of general principles, such as a resolution by the UN. While such a declaration may contain various kinds of principles, environmental law principles will be necessary since they definitely relate to protecting the environment of outer space.

In our observation, Article IX of the Outer Space Treaty can be adopted as a general principle for protecting the environment in outer space. The concept of sustainable development, a trend in environmental law, is worthwhile considering as the implementing principle for Article IX of the Outer Space Treaty. As we indicated in our review, there is no theoretical difficulty in applying the concept of sustainable development for solving space debris problem. Controversial principles, such as precaution and polluter-pays, could be excluded for the time being, although they are the heart of environmental law.

Additionally, since developed countries and developing countries generally have a positive image of the sustainable development concept, employing it in a future legal instrument, such as listed in the preamble or elsewhere, probably be welcomed as an extension of the international cooperation for environmental protection in the field of space activities.

In conclusion, the concept of sustainable development can provide us profound implications for the future legal framework for regulating space debris. This point should be examined further, yet there have been few academic opinions with regard to it.

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[17] ibid. note 10. pp.345-347,There are the two schools of thought with regard to space debris problems. Developed countries insist that scientific uncertainty requires further research rather than international regulation, and developing countries insist that international regulation is indispensable because the failure to act could lead to irreversible harm, which is the same as the negotiation of the UNCED.