SMART Technologies for the Prevention and Compensation of Environmental Damage in the Context of Sustainable Development

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Abstract. The author analyzes the application of SMART technologies for the prevention and compensation of environmental damage. Considering that any activity is presumed to be dangerous and that the accumulated environmental damage is vast, the prevention and compensation of ecological damage are increasingly important. The author analyzed SMART technologies to prevent and compensate for ecological damage that ensure sustainable development and conservation of natural resources. This study is of practical significance due to the deterioration of environmental conditions. The elimination of the negative consequences of innovative, economically oriented activities through SMART technologies will ensure sustainable development and nature conservation. The author analyzed the theoretical, ecological, and legislative aspects of SMART technologies. The author defined the “SMART” acronym and gave analogs and interpretations of non-legal terms related to the environmental legislature and human rights. Additionally, the author compared technologies and techniques for identifying and systematizing the procedures of ecological compensation. The technologies of prevention and compensation were differentiated.

Keywords: SMART technologies · Ecological damage · Environmental damage · Ecogenic damage · Law enforcement technologies · Prevention and compensation of environmental damage · Sustainable development · Conservation of natural resources · Compensatory ability of nature

1. Introduction

Global trends in economic development, the globalization of social processes, and technological advances lead to environmental stress. The innovations that accompany the socio-economic, political, and legal functioning of states do not contribute to sustainable development and conservation of natural resources. The prevention and compensation of environmental damage and supporting the compensatory ability of nature are still relevant due to the increasingly deteriorating environment. Current problems in this sphere include inefficient exploitation of natural resources, flaws of the ecological legislature, and low international and intra-national environmental security. These problems are prerequisites to improving the methods of preventing environmental damage and applying technologies for reducing environmental damage. SMART technologies allow modernizing ecological protection, implementing sustainable development principles, and conserving natural resources.
2. Materials and Methods
The author used a set of general scientific methods: (1) analysis (to interpret the concepts and reveal their features), (2) synthesis (a generalization of discussion conclusions and opposing definitions), and (3) the method of analogy (projecting the theses and descriptions of this research unto legal relations). The author also employed such specialized judicial methods as formal-legal and comparative-legal. The author analyzed such legislative sources as the Constitution of the Russian Federation, the Federal Law “On environmental protection,” and other domestic and international legislative sources on sustainable development. Employing formal-legal and comparative methods, the author analyzed judicial, philosophical [7], and ecological legal works [1, 4, 5, 6, 8].

3. Results
The term “SMART technologies” correlates with the word “smart technologies.” Both terms denote the technologies used in everyday life to meet individual and societal needs in an eco-friendly way, ensure national development, and intensify global integration. In this research, the term “SMART technologies” is used in the context of globalization and sustainable development. SMART is an abbreviation of the words “specific” (S), “measurable” (M), “attainable or attractive” (A), “resource-supplied” (R), and “time-bound” (T). The term refers to a combination of techniques, measures, tactics, and means applied in a set sequence.

After analyzing the discussion on the correlation of the terms “technology” and “technique,” the author of this study confirmed that the term “technology” is broader. The term “SMART technologies” is broader than “technique” as it includes different methods, tools, and techniques for optimizing the result optimization. In the context of sustainable development, SMART technologies encompass the ways and means of rehabilitating damaged environmental standards, the procedures of fulfilling tort obligations, and monetary compensation for ecological harm. SMART technologies include a system of ecologic fines and methods, expert conclusions, and tools of ecological compensation. They are applied in a set sequence and form a functioning mechanism of the equipment, as well as standard techniques and means to achieve sustainable development.

SMART technologies reflect the multifaceted experience gained by humanity throughout its existence. They improve the quality and speed of various daily operations and perfectly fit environmental legislation and human rights. SMART technologies allow developing high-profile objects like smart systems and green technologies and small-scale objects like smart trashcans and packaging. Therefore, SMART technologies solve the environmental problems of modern society and ensure the interests of the economy through sustainable development and environmental protection.

Hence, in the context of sustainable development, SMART technologies:

- (S) answer the questions – “What? When? Why?”;
- (M) have in their basis the techniques measuring and predicting the desired outcome;
- (A) use the best available tools, techniques, and means to achieve the result;
- (R) preserve the resource balance during the development, organization, and implementation of the process stages;
- (T) aim to get the result at the predetermined time.

In the context of resource conservation, the term “SMART technologies” is multifaceted since it contains natural and anthropogenic traits. Some examples of these technologies are hybrid vehicles, wind power generators, solar cells, etc.

Completely natural technologies (e.g., moving the ship with the current) are preferable to ensure environmental conservation. However, they do not account for the increased economic growth and must be used in combination with anthropogenic technologies.

Anthropogenic technologies allow solving problems with the help of technical means and accelerating economic growth by observing standards and rules. However, these technologies potentially cause environmental harm and are not conducive to sustainable development. Still, some anthropological technologies can be economically lucrative and ecologically friendly. That is, human
needs can be fulfilled by means excluding the use of natural resources (artificial fur, plant food instead of meat-based produce).

Such “positive” anthropogenic technologies also include legal measures to prevent and compensate for environmental damage. Therefore, in the framework of sustainable development, SMART technologies are predominantly anthropogenic (i.e., created and applied by humans). These technologies are aimed at ensuring the compensatory ability of nature and environmental damage prevention compensation.

Environmental damage may be caused by a violation of existing rules and regulations or unlawful actions leading to changes in the environment and harming citizens and their possessions. In the current civil legislation, the term “damage” entails such notions as material harm and opportunity and monetary losses. Therefore, environmental “damage” has direct and indirect factors. The direct factors include material damage (degradation of nature, destruction, damage, depletion of natural resources, destruction of ecological systems), opportunity losses (loss of income due to the damaged environment, e.g., polluted land may be uncultivable); immaterial damage (a result of environmental offenses and crimes that entailed physical and moral harm). The indirect factors include demographic decline (lower birth rates, higher death rates, lower quality of healthcare caused by pollution), climate change, increased frequency of natural disasters, the disappearance of natural objects, extinction of wildlife and plants, etc.

Preventing environmental harm is the cornerstone of the principles of natural resource conservation and sustainable development.

E. V. Garifullina and D. I. Akhmedyanov propose to introduce the term “best available technologies” into the Federal Law “On Environmental Protection,” making a distinction between it and the “best available technologies.” The term “best available technologies” refers to the technologies based on modern scientific and technological advances that are best suited for achieving environmental protection goals and feasible in their application. Sometimes, these types of technologies are referred to as “green” technologies or ecologically safe technologies. The result of such a distinction is in the “separation of the ‘actually existing’ (best existing technologies) and ‘practically applicable’ (best available) technologies” [5].

Both terms denote technologies that aim to prevent or minimize adverse environmental impacts. Therefore, they are included in the technologies for preventing environmental damage.

The technologies for compensating for environmental damage should be applied to compensate for the damage caused to the environment and human health and restore the damaged ecosystems.

Both types of technologies are crucial for the conservation of natural resources and the compensatory ability of nature.

Given the definition of “SMART,” the technologies for preventing and compensating for environmental damage should also be called “SMART.” They include:

- (S) law enforcement technologies for the prevention and compensation of environmental and health damage (e.g., assessment of environmental impact, ecological damage fines, ecological expertise, compensation for material and immaterial damages, environment restoration);
- (M) methods, rates, and expert opinions measuring and predicting the result (environmental damage (including potential damage), restoration costs of natural and natural-anthropogenic objects);
- (A) innovative tools, techniques, and means to achieve the result (combining legal measures with information resources, technological developments, etc.);
- (R) specific legally fixed sequences (court trials, administrative procedures, recultivation projects);
- (T) the prevention and compensation of environmental damage, compensation of the restoration costs, and bringing the cause of the harm (whether guilty or not) to justice according to the law.

4. Discussion
The definitions of “technology” and “technique,” the separation of these terms, and the issue of measuring ecological harm are debatable. When analyzing the term “technology” in “SMART
technologies”, the author encountered such notions as “means”, “know-how”, “techniques”, “tactics”, “solutions”, and “methods.” The term “technology” more often correlates with the notion “technique,” which predetermines the discussion of the relationship between them, their content, essence, and separation.

The traditional interpretations of “technique” are “technocratic,” “natural-scientific,” and “sociocultural” [8]. Scientific achievements and high personnel professionalism form the basis of the technocratic approach. The natural-scientific approach encompasses natural laws and natural materials used by humanity for technical purposes. The socio-cultural approach combines two previous approaches. It indicates that technological advances and nature co-relate, using society and its practical and scientific activities as a link. Since scientifically unsubstantiated technical actions are legally inactive, the author concluded that the socio-cultural approach is the most suitable in the context of SMART technologies.

The term “technique” is interdisciplinary. The philosophical understanding of “technique” includes scientific knowledge on using technical devices to achieve the result. The general interpretation of “technique” refers to different, but related phenomena – “a set of human activity means” and “a set of methods, techniques, and skills for any activity” [8]. The first phenomenon is static and includes specific tools required to perform a particular activity. In contrast, the second one is dynamic. It covers the study of production means, their use, and application methods. SMART technologies involve dynamic activity employing a set of static tools to remediate environmental damage. They express themselves in actions to compensate for environmental damage. These are actions:

- aimed to restore the damaged environment (e.g., environmental administrative penalties, environmental insurance, and taxation);
- aimed to compensate for the damage resulting from an ecological offense (e.g., procedures on non-contractual tort obligations that serve as a basis for environmental crimes, insults, and misdemeanors);
- aimed to restore the situation that existed before the ecological damage (ecological rates, methods, expertise, and restorative legal measures).

In the context of SMART technologies, the terms “technique” and “technology” can be unrelated, separated, or syncretized.

If one considered the terms “technology” and “technique” to be separate, then the word “technique” would include momentary rules, methods, and means of compensation for environmental damage. Simultaneously, “technology” would encompass the long-term methods and stages of compensation for environmental damage. In this study, SMART technologies are considered dynamic structures.

If one assumes that “technique” is a part of “technology,” it is evident that the latter is an interconnected structure in which specific means and methods (the technique) are applied in a given sequence (according to the fixed technology). This fact also confirms the dynamic structure of SMART technologies.

The idea that the terms “technique” and “technology” are identical presupposes that they are interchangeable; its means and methods are used as an algorithm.

In the context of sustainable development, SMART technologies are law-related since they function in criminal or administrative enforcement (in a court dispute or administrative law practice). Therefore, the means of preventing and compensating for environmental damage demonstrate that a clear separation of “technique” and “technology” is impossible.

In the context of using SMART technologies for environmental damage compensation, the term “technique” is defined as a set of human actions aimed at the implementation of the procedure and process. In contrast, the “technology” reflects the operations in the industrial process. That is, the “technique” is a set of tools used in set algorithms, and “technology” is a series of operations, procedures, and measures. By projecting this methodological scheme, one can see that environmental damage can be repaired through technical activities using specific devices, means, and techniques, which result from scientific findings and legal requirements.
Thus, the term “technology” must be applied to the compensation for environmental damage, even though “technique” is a proven and established phenomenon applicable to technological processes. The attainability of the full compensatory capacity of nature depends on the theoretical interpretation of the term “environmental damage.”

The definition of “environmental damage” is not legally established. However, Article 1 of the Federal Law “On Environmental Protection” defines environmental damage as negative changes caused by pollution, resulting in the degradation of natural ecological systems and depletion of natural resources. The doctrinal interpretation and legal interpretations of “environmental damage” are identical [2]. The secondary literature on the topic lists such notions as environmental damage, ecogenic damage, ecological damage, and damage in the ecosphere. Environmental damage is “any environmental degradation caused by violation of environmental legislation and any related reduction of tangible and intangible benefits, protected by law, including human life and health, personal and corporate property” [1]. Damage to the ecosphere is “long-term or permanent loss of a person’s health, total or partial destruction of their property, negative short-term and long-term changes in the quality of the environment resulted by the violation of ecological legislation, an influence of a hazardous source, or legal activities. Ecological (echogenic) harm is an act caused by a violation of legal and environmental requirements, and a related reduction of tangible and intangible benefits, including human life and health, personal and corporate property” [3].

5. Conclusion
The importance of SMART technologies for the prevention and compensation of environmental damage in the context of sustainable development and resource conservation is explained by the following:

- Regulatory gaps and flaws (there are too many legal regulations; they are declarative, fragmented, irrelevant, conflicting, etc.);
- The critical condition of the State and Public Administration for Environmental Protection (e.g., there are no authorities that organize land use in the system of resource management);
- Improper control and supervision over the rational use of environmental components and ensuring ecological safety;
- Mass environmental nihilism;
- Low environmental responsibility of the population, which is increasingly moving into the virtual world due to the development of the Internet, dulling the importance of ecological problems.

These facts are further worsened by social and economic factors harmful to the environment. “Sustainable development must be assured by environmentally sound economic and social development” [4]. SMART technologies for the prevention and compensation of environmental damage are a system of doctrinally validated and tested methods and techniques in law enforcement aimed at supporting the compensatory ability of nature, conserving natural resources, and implementing the principles of sustainable development. Therefore, nowadays, refusing the introduction of SMART technologies is impossible since the world-wide well-being of the environment is an essential criterion for the survival of humankind. The prevention and compensation of environmental damage using SMART technologies have become increasingly important due to the need for resource conservation and sustainable development.

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