doi.org/10.36073/1512-0902-2026-139-147-151
UDC: 504.05/.06

Developing new strategic ways to develop environmental education

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Abstract. According to the UN Environment Programme (UNEP) report, the forecast for human development to 2032 is disappointing: More than 70% of the Earth's surface will be deformed in one way or another, more than a quarter of all animal and plant species will be irreversibly lost, and safe air and clean drinking water will become irreparably scarce.; scientific and technological progress has created the risk of environmental catastrophe, and the very concept of "development" has been called into question.

In 2021, the WHO took into account new research on the dangers of air pollution and revised almost all target concentrations of air pollutants, reducing their maximum permissible levels by 1.1 to 4 times.

Characteristics and indicators of atmospheric air pollution from 2025 include monitoring of key pollutants such as particulate matter ($PM_{2.5}$, PM_{10}), nitrogen dioxide, sulfur dioxide, carbon monoxide (CO), ozone (O_3) and radioactive substances, assessed according to international (WHO) and national standards - Maximum Permissible Concentration (MPCs).

Keywords: Environmental education, ecology, new strategy

Introduction. To successfully implement environmental policy and effectively manage environmental conditions, reliable, comprehensive, and timely information is needed on the availability and condition of natural resources, environmental quality and pollution, as well as the causes and consequences of adverse environmental situations, emergencies, and disasters.

Environmental monitoring is a means of obtaining, processing, storing, and displaying information that forms the basis for forecasts and, ultimately, for developing environmentally safe decisions. Thus, the development of an environmental monitoring system plays a key role in environmental protection and environmental management. Consequently, in a number of countries, the course "Environmental Monitoring" is included in the special disciplines (SD) program, the teaching goals of which are:

- developing an understanding of the current state of the environment, taking into account the ever-increasing anthropogenic impact on it;
- familiarizing students with the main principles of environmental research to obtain optimal information about the state of the environment and its components when substantiating and refining environmental forecasts.

Main part. Air pollution monitoring is a system of regular, long-term observations in space and time, providing information on the state of air pollution for past, present, and future assessments. Environmental protection has always been a concern due to its harmful impact on public health. For example, air pollution is a contributing factor to allergies and respiratory diseases. This is why the quality of the air we breathe is so important.

Elevated concentrations of pollutants are observed in the atmosphere of virtually every major city, negatively impacting the ecosystem and the health of its residents. Air composition can vary over time and space. This is facilitated by pollutant emissions, weather conditions, and geographic location. Both anthropogenic and natural sources of pollution play a major role in shaping the qualitative and quantitative composition of atmospheric air: - natural sources of atmospheric pollution include volcanic eruptions, forest fires, dust storms, weathering processes, and the decomposition of organic matter; - anthropogenic sources of atmospheric pollution include industrial and thermal power plants, transport, home heating systems, agriculture, and household waste. Economic activities in sectors such as energy, transportation, agriculture, and waste management emit pollutants or chemical compounds into the air, which, through various chemical reactions, form secondary air pollution. Accelerating urbanization also significantly increases air pollution. Today, more than half of the world's population lives in cities, which, while often a source of air pollution, are also where the effects of air pollution are felt most acutely.

The ecologically induced threat to the existence of human civilization has been officially recognized at the highest international level; scientific and technological progress has created the risk of environmental catastrophe, and the very concept of "development" has been called into question. An urgent need has emerged to reexamine the scale of human values. Consumerism has pushed nature to the brink of extinction.

Dominant patterns of production and consumption are leading to environmental devastation, increasing risks to human life and health due to declining environmental quality. The foundations of global security are under threat.

Results. According to the UN Environment Programme (UNEP) report, the forecast for human development to 2032 is bleak [1]. Human activity will cause irreversible changes to the planet. More than 70% of the Earth's surface will be deformed in one way or another, more than a quarter of all animal and plant species will be irreversibly lost, safe air, clean drinking water (according to the WHO, 80% of all diseases worldwide are already caused by the consumption of poor-quality drinking water), and undisturbed landscapes will become irreparably scarce, and nature's ability to recover from anthropogenic impacts will be diminished.

Atmospheric air, as a component of natural resources, is a national treasure and is protected by the state. Therefore, strict, scientifically based quality control is so important. Elevated concentrations of pollutants are observed in the atmosphere of virtually every major city, negatively impacting the ecosystem and the health of its residents [2, 3, 4]. Air pollution knows no boundaries: emissions from a source in one country can be transported and deposited in another, sometimes thousands of kilometers away.

Table 1. Comparison of permissible average daily concentrations of harmful substances in the air according to WHO recommendations and Russian air quality standards (SanPiN)

Harmful substance	Average daily concentration, WHO, μg/m³	Average daily concentration, SanPiN, μg/m³	Difference in indicators
$PM_{2.5}$	15	35	SanPiN requirements are 2.3 times lower
PM_{10}	45	60	SanPiN requirements are 1.3 times lower
Ozone (O_3)	100*	100*	SanPiN requirements comply with WHO
Nitrogen dioxide (NO_2)	25	100	SanPiN requirements are 4 times lower
Sulfur dioxide (SO_2)	40	50	SanPiN requirements are 1.25 times lower
Carbon monoxid (CO)	4000	3000	SanPiN requirements are 1.3 times higher

Table 2. Comparison of permissible average annual concentrations of harmful substances in the air according to WHO recommendations and Russian air quality standards (SanPiN)

Harmful substance	Average annual concentration, WHO, μg/m³	Average annual concentration, SanPiN, μg/m³	Difference in indicators
$PM_{2.5}$	5	25	SanPiN requirements are 5 times lower
PM_{10}	15	40	SanPiN requirements are 2.7 times lower
Ozone (O_3)	60**	30	It is impossible to compare
Nitrogen dioxide (NO_2)	10	40	SanPiN requirements are 4 times lower
Sulfur dioxide (SO_2)	-	-	-
Carbon monoxide (CO)	-	3000	-

In the given 1 and 2 tables we present the air quality criteria recommended by WHO and the Maximum Permissible Concentrations (MPC) established in Russia for some pollutants, μg/m³.

Air quality standards in force in Russia are significantly less stringent than WHO recommendations: the difference in indicators ranges from 1.25 to 5 times. This leads to greater air pollution than if WHO standards were in effect. The WHO Air Quality Guidelines are an international standard that sets out recommended standards for maximum concentrations of harmful substances in the air.

According to a rapid analysis of potential scenarios conducted by WHO, nearly 80% of deaths due to exposure to $PM_{2.5}$ particles worldwide could be prevented by reducing current air pollution levels to those recommended in the updated guidelines. At the same time, achieving intermediate targets would reduce the disease burden, particularly in countries with high concentrations of fine particulate matter ($PM_{2.5}$) and large populations.

In 2021, the WHO took into account the results of new research on the harm of air pollution and revised almost all target concentrations of air pollutants, reducing their maximum permissible levels by 1.1 to 4 times [5, 6].

The permissible average annual concentration of $PM_{2.5}$ was reduced by half - from 10 to 5 μg/m³, and the permissible daily concentration - from 25 to 15 μg/m³. The permissible average annual concentration of PM_{10} was reduced from 20 to 15 μg/m³, and the daily concentration - from 50 to 45 μg/m³ [6].

The Second WHO Global Conference on Air Pollution and Health concluded (March 28, 2025) with the adoption of the aforementioned important commitments by more than 50 countries [7]. In particular: - a decision was made to accelerate

actions to ensure clean air, access to clean energy and mitigate climate change; - highlighted evidence-based, coordinated, multifaceted solutions in cities, countries and regions to prevent various diseases, save lives, protect children's health and limit climate change worldwide. In addition, it was decided that the countries participating in the conference commit to reducing air pollution by 2030 and beyond.

Characteristics and indicators of ambient air pollution from 2025 include monitoring of key pollutants such as particulate matter ($PM_{2.5}$, PM_{10}), nitrogen dioxide, sulfur, carbon monoxide (CO), ozone (O_3) and radioactive substances, with an assessment according to international (WHO) and national standards - Maximum Permissible Concentration (MPC).

Data for 2025 show persistent problems for a significant portion of the population in both Georgia (monthly bulletins) and globally, related to $PM_{2.5}$ exceedances and rising CO_2 emissions, despite efforts to reduce them. 2025 trends: - Global: - 36% of the world's population is exposed to $PM_{2.5}$; - US: - 2.4% increase in greenhouse gas emissions from fossil fuel combustion compared to the previous year, a negative trend.

Georgia, like other countries, faces poor air quality in cities, where standards for nitrogen oxides, sulfur, formaldehyde, benz(a)pyrene and dust are often exceeded. As a result, on June 26, 2025, Amendments to the Georgian Law on Atmospheric Air Protection were adopted as a preventive measure aimed at improving atmospheric air quality.

The main changes concern tightening the regulation of harmful substance emissions, strengthening control mechanisms and bringing air quality closer to European standards, which will reduce anthropogenic impact.

In particular, the air quality management plan approved by the Georgian government is aimed at reducing air pollution and improving the environmental situation in the country [7]. The plan includes measures to reduce harmful substance emissions, increase the amount of green spaces and regulate traffic flow.

Furthermore, it should be noted that raising the level of environmental education and awareness occupies an important place in all program documents of the Government of Georgia [8, 9, 10]. In particular, the new government program (2021–2024) "For Building a European State" envisages strengthening activities aimed at promoting environmental education and raising environmental awareness, as well as integrating environmental education issues into the school and higher education systems.

Global environmental problems - pose the greatest threat to our planet, as they impact the entire world. They develop gradually, as a result of long-term impacts on the natural environment, and therefore, the desire alone is not enough to solve them - requires significant effort to prevent environmental catastrophe.

Overpopulation of our planet is one of the most pressing environmental problems of our time, as it exacerbates all other problems. The problem of natural resource depletion encompasses not only the depletion of minerals (such as metals or oil), but also the depletion of land resources (decreased soil fertility), water resources (depletion of fresh water reserves), forest resources (decreasing forest cover), and so on. The problem is dangerous precisely because of its scale - our planet is slowly dying, but it can still be saved.

Global climate change is driven by a multitude of factors that lead to massive alterations in natural processes and established norms. Abnormal temperature fluctuations are observed, precipitation patterns are changing, and natural disasters are occurring everywhere, causing enormous damage (Fig. 1).

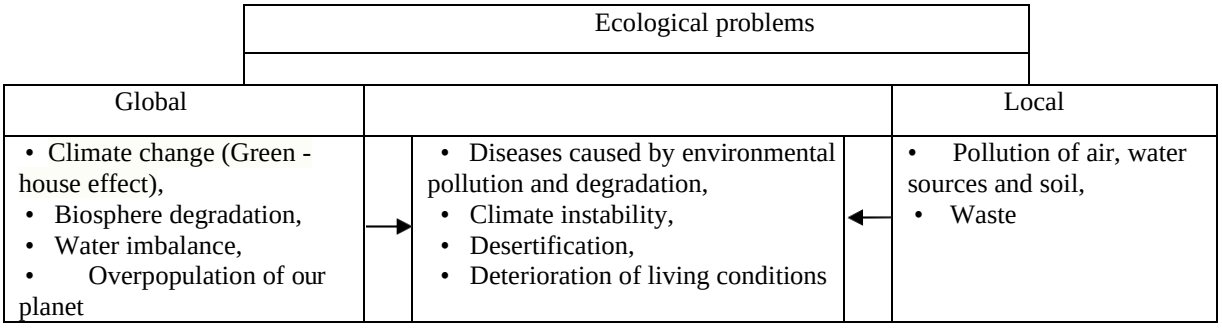

Fig. 1. The relationship between global and local environmental problems

The problem of ozone layer depletion became a pressing concern at the end of the last century. At that time, considerable panic ensued, leading to the adoption of a number of measures to slow the process of ozone layer depletion. However, the problem has not yet been fully resolved, remaining a global environmental threat.

Environmental pollution causes significant damage to nature. This occurs because harmful substances enter natural systems, disrupting their functioning (even leading to their destruction). However, statistics indicate that the pollution problem is only getting worse, causing ever greater harm.

Desertification is a global problem, characterized by the transformation of fertile lands into desert. In the future, this threatens our planet with the destruction of most of its flora and fauna.

The decline of Earth's biodiversity is a contemporary environmental problem that could develop into a real environmental catastrophe in the future. The extinction of living organisms and the decline in species diversity on our planet lead to an imbalance in the natural balance, which leads to the disruption of natural systems. And this is a very serious problem.

Food shortages have long been a pressing issue in many countries around the world. The problem is only worsening over time, spreading to new regions (primarily due to population growth). And there's a risk of further spread in the near future.

Conclusion. New scientific research on the impact of air quality on human health shows that the harm caused by air pollution has previously been underestimated. This is why the WHO is calling on countries to revise their domestic air quality standards. It should be noted that, along with climate change, air pollution is one of the most serious environmental threats to human health.

The new Global Air Quality Guidelines (GAQGs) prepared by the World Health Organization (WHO) present clear evidence of the harm air pollution causes to human health, even at lower pollutant concentrations than previously thought. The document recommends new air quality targets, the implementation of which will protect public health by reducing concentrations of key pollutants, some of which also contribute to climate change.

Since the last update of the WHO global guidelines in 2005, the body of scientific evidence on the negative impacts of air pollution on various aspects of human health has increased significantly, demonstrating its detrimental impact on health even at low concentrations.

New data has led to a revision of WHO recommendations (2021), confirming that 99% of the world's population breathes unsafe air, causing millions of premature deaths annually. For this reason, and following a systematic review of the accumulated data, WHO has adjusted almost all recommended air pollution limits downwards, warning that exceeding the new maximum permissible concentrations of pollutants.

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doi.org/10.36073/1512-0902-2026-139-147-151
UDC: 504.05/.06

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Transactions IHM, GTU. -2026. -vol.139. -pp. 147-151. - Eng., Summ. Georg., Eng. Rus.

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doi.org/10.36073/1512-0902-2026-139-147-151
უაკ: 504.05/.06

გარემოსდაცვითი განათლების განვითარების ახალი სტრატეგიული გზების დამუშავება. გუნია გარი, სვანიძე ზიზი. ჰმი-ის შრომათა კრებული-2026.-ტ.139.-გვ. 147-151. - ინგლ. რეზ. ქართ. ინგლ. რუს.

გაეროს გარემოსდაცვითი პროგრამის (UNEP) ანგარიშის თანახმად, 2032 წლამდე ადამიანის განვითარების პროგნოზი იმედგაცრუებას იწვევს: დედამიწის ზედაპირის 70%-ზე მეტი ასე თუ ისე დეფორმირდება, ყველა ცხოველთა და მცენარეთა სახეობის მეოთხედზე მეტი შეუქცევადად დაიკარგება, ხოლო უსაფრთხო ჰაერი და სუფთა სასმელი წყალი შეუქცევადად დეფიციტური გახდება; სამეცნიერო და ტექნოლოგიურმა პროგრესმა გარემოსდაცვითი კატასტროფის რისკი შექმნა და „განვითარების“ კონცეფცია კითხვის ნიშნის ქვეშ დადგა.

2021 წელს ჯანმო-მ გაითვალისწინა ჰაერის დაბინძურების საფრთხეებთან დაკავშირებული ახალი კვლევები და გადახედა ჰაერის დამაბინძურებლების თითქმის ყველა სამიზნე კონცენტრაციას, რითაც მათი მაქსიმალური დასაშვები დონეები 1.1-დან 4-ჯერ შეამცირა. ატმოსფერული ჰაერის დაბინძურების მახასიათებლები და ინდიკატორები 2025 წლიდან მოიცავს ისეთი ძირითადი დამაბინძურებლების მონიტორინგს, როგორიცაა მყარი ნაწილაკები (PM2.5, PM10), აზოტის დიოქსიდი, გოგირდის დიოქსიდი, ნახშირბადის მონოქსიდი (CO), ოზონი (O3) და რადიოაქტიური ნივთიერებები, რომლებიც შეფასებულია საერთაშორისო (ჯანმო) და ეროვნული სტანდარტების - მაქსიმალური დასაშვები კონცენტრაციების (MACs) მიხედვით.

doi.org/10.36073/1512-0902-2026-139-147-151
УДК: 504.05/.06

Разработка новых стратегических путей развития экологического образования./Гуния Гарри, Сванидзе Зизи./Сб. Трудов ИГМ ГТУ. - 2026. – том 139. - с. 147-151. - Англ.; Рез: Груз., Англ.,Рус.

Согласно докладу Программы ООН по окружающей среде (ЮНЕП), прогноз развития человечества до 2032 года неутешителен: более 70% поверхности Земли будет деформировано тем или иным образом, более четверти всех видов животных и растений будут безвозвратно утрачены, а чистый воздух и чистая питьевая вода станут непоправимо дефицитными; научно-технический прогресс создал риск экологической катастрофы, и само понятие «развития» поставлено под сомнение. В 2021 году ВОЗ учла новые исследования об опасностях загрязнения воздуха и пересмотрела почти все целевые концентрации загрязняющих веществ в воздухе, снизив их максимально допустимые уровни в 1,1–4 раза.

Характеристики и показатели загрязнения атмосферного воздуха с 2025 года включают мониторинг ключевых загрязняющих веществ, таких как твердые частицы ($PM_{2.5}$, PM_{10}), диоксид азота, диоксид серы, оксид углерода (CO), озон (O_3) и радиоактивные вещества, оцениваемые в соответствии с международными (ВОЗ) и национальными стандартами – предельно допустимыми концентрациями (ПДК).