РОЗДІЛ 1

Економіка природокористування і еколого-економічні проблеми

Economic, Environmental and Social Challenges of Science for Achieving Sustainable Development Goals: the EU and World Experience

Leonid Hr. Melnyk[i], Oleksandra I. Karintseva[ii], Iryna B. Dehtyarova [iii]

The article analyses economic, environmental and social challenges of science for achieving sustainable development goals incorporating the EU and world experience. It tackles the studies of three interconnected global problem areas: Energy and Climate Change, Food and Water, Poverty and Equity. It overviews research progress in developing new methods for optimizing long-term economic growth, science education; science and food security; alternative energy sources; artificial intelligence and digital transformations; art education as well as the EU and world experience in using motivational instruments for implementation sustainable development goals and tackling global environmental challenges on the global, regional, national and local levels.

Keywords: science, sustainable development goal, system, economic growth.

УДК 330.366:502.131.1:[620.9+338.439]:316.422.44 *JEL коди*: A13, O33, Q20, Q30, Q32

Introduction. The power of science is significant in solving endless environmental, economic and social problems of current socio-economic systems. Under the heading "Science for Peace", the World Science Forum (WSF) 2017 on the Dead Sea in Jordan (7–11 November 2017) attracted over 3.000 participants from 140 countries representing the scientific community, policy makers, international organizations, and youth. Hosted by the Royal Scientific Society of Jordan, together with UNESCO, the Hungarian Academy of Science, the International Council for Science, and the American Association for the Advancement of Science, the Forum provided an opportunity to engage the world of science and redefine the global potential of scientific communities and policymakers to bring real change to our interlinked societies. World Science Forum 2017 mainly focused on the critical interdependency of water, energy and food as the most acute challenge to peace and security.

[i] *Leonid Hr. Melnyk*, Dr. (Economics), Professor, Head of the Department of Economics and Business Administration, Sumy State University;

[ii] *Oleksandra I. Karintseva*, C.Sc. (Economics), Associate Professor, Vice Head of the Department of Economics and Business Administration, Sumy State University;

[iii] *Iryna B. Dehtyarova*, C.Sc. (Economics), Associate Professor, Associate Professor of the Department of Economics and Business Administration, Sumy State University.

Problem. Scientific and technological advances are at a point where challenges to our health, environment and wellbeing may be defined and addressed in increasingly effective ways – the 8th WSF declares. "Science for Peace" signifies a call for the attainment of the Sustainable Development Goals, and for the promise of hope and opportunity in the lives of all people in a world where borders must matter little as we struggle to build a better, and inevitably shared future.

Recent research. Issues of economic, environmental and social challenges of science were raised by P. Kabat [11], D. G. Saari, K. W. Steininger [20], C. Lininger, L. H. Meyer, P. Munoz, T. Schinko, J. Rojelj [19], etc. Sustainable development issues were tackled by H. Daly [8], H. Odum [3], R. Perelet [4], E. Weizsäcker [1, 2], etc.

Goal of the article. Distinguishing economic, environmental and social challenges of science for achieving systems' sustainable development goals and key interactions with other goals.

Sustainable Development Goals. On 1 January 2016, the 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development – adopted by world leaders in September 2015 at an historic UN Summit – officially came into force. Over the next fifteen years, with these new Goals that universally apply to all, countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind.

For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and people, who want to be involved to contribute to a sustainable future. Sustainable Development Goals (SDGs) are the following [21]:

1) End poverty in all its forms everywhere.
2) End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3) Ensure healthy lives and promote wellbeing for all at all ages.
4) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5) Achieve gender equality and empower all women and girls.
6) Ensure availability and sustainable management of water and sanitation for all.
7) Ensure access to affordable, reliable, sustainable and modern energy for all.
8) Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
9) Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
10) Reduce inequality within and among countries
11) Make cities and human settlements inclusive, safe, resilient and sustainable
12) Ensure sustainable consumption and production patterns
13) Take urgent action to combat climate change and its impacts (taking note of agreements made by the UNFCCC forum)
14) Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss.
16) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

17) Strengthen the means of implementation and revitalize the global partnership for sustainable development.

There is a strong interaction between all Sustainable Development Goals to achieve global priorities and objectives that are fundamentally interdependent. Only highly effective governance systems, institutions, partnerships, and intellectual and financial resources can effectively implement SDGs.

The basic role of science here is to overcome possible economic, environmental and social challenges on the way to sustainable development implementation.

Economic, environmental and social challenges of science. In 2017 scientific community gathered in Jordan November 7–11 for World Science Forum "Science for Peace" reflected on lasting peace, that 'may only be achieved in our world when scientific knowledge is more equitably produced and shared, when science and evidence-based thinking are supported and empowered in all societies, when diversity is cherished as a vital factor in science and research, and when the universal right to science is promoted and enshrined in regional and global fora' [23].

Speakers of the Forum presented their ideas through 9 plenary and 12 thematic session and various side events for selected audiences. In the course of 9 plenary and 12 thematic sessions and over 90 lectures the most excellent speakers of the world of science, politics and society presented their views to the participants of the Forum.

Major global problems based on the importance of the problem on the global agenda; National Member Organizations interest in identifying solutions to the problem; and world science capabilities to conduct research to find solution were selected: [18, p. 10].

Food and water Reducing hunger and starvation in the world and providing secure water supplies for agriculture, human consumption, industry, and nature; improving land use planning and management to achieve a stable world food supply; addressing the interactions between fresh water, agriculture, forestry, food, fishery, energy, and health; and analyzing the impacts of economic development, demographic change, environmental impacts, and climate change on ecosystem services.

Energy and climate change Alleviating energy poverty in underserved regions and providing energy security worldwide; assessing the interactions between energy supply and end use, economic development, environmental impacts, particularly climate change and air pollution and loss of ecosystem services; guiding the way to economically and environmentally sustainable energy futures.

Poverty and Equity Reducing the gap between the rich and the poor; understanding gender and education inequities and how to reduce them; assessing the impacts of drivers of global change on inequities, including development and urbanization, globalization, population growth and migration.

As a result the Declaration of the 8th World Science Forum on Science for Peace was adopted. It states the necessity of the international cooperation and the leading role of science for sustainable development. The basic call was on [22]:

- equitable and sustainable management of natural resources is essential to avoid conflicts and to promote peaceful development;
- the preservation of scientific capacities, threatened by global migration trends, which is key to peace, sustainable development, resilience and recovery;
- diversity as a key enabler of excellence in science, technology and innovation and is essential to optimize its relevance and impact; commitment to the fulfillment of the universal right to science;

- support for the launch of a regional science forum for the Arab World.

The Forum discussed a number of important issues: science education; science and food security; alternative energy sources; artificial intelligence and digital transformations; art education; new methods for optimizing long-term economic growth, etc.

Science education. Education is the key tool in combating poverty and promoting peace, social justice, human rights, democracy, intercultural understanding and environmental awareness. In this context, it is imperative for scientists and educators to promote and shape science education and to facilitate global science literacy, to support equal opportunity and to empower and inform global citizens. Good science education can help to give all people a voice to challenge injustice and inequality and enable them to make informed decisions about the way they live their lives.

Science education and engagement beyond the classroom can also help to achieve these aspirations. Traditional science communication activities, through the media and science museums, are increasingly being complemented by social media, science centres, and new ways of communicating science through art and civil society engagement. Developments and deployment of ICT is transforming the way science is communicated to all ages and in many contexts [16].

Science and food security. The relationship between peace, conflict and food security is historic and well documented. The threat of hunger is a powerful driver of instability, anger and violence, while actions to promote food security can help prevent crisis, mitigate its impacts, and promote recovery, healing and growth. But sustainable and equitable access to food for all is becoming increasingly challenging as consumption patterns and dietary expectations change rapidly. Further, the relationship between global food production and a variety of factors including health, nutrition, agriculture, climate change, water and energy management, ecology and human behaviour is complex and characterised by inequality and imbalances. The Sustainable Development Goals provide a critically important framework for addressing these challenges but require an integrated scientific approach to understand and account for these interdependencies [9, 16, 23].

Alternative energy sources have an undeniable advantage. They are much more environmentally friendly than traditional methods of generating energy based on burning fossil fuels. However, they have a number of obvious qualities that favorably distinguish them from representatives of traditional energy.

Renewable energy sources are characterized by stability and relative inexhaustibility, which allows them to ensure a stable operating mode of energy systems, and with them – of the entire economy. The work of the sun and wind is characterized by stable regularity. There are already technical solutions that ensure the operation of wind power stations with minimum wind speed and even complete calm. Geothermal heat is an even more stable source. In combination with effective means of energy storage and storage, these sources provide a stable mode of operation of the power system both for energy supply and for the price of energy produced. This allows establishing and a stable order of regulation (diversification of selling prices depending on the time of day and seasonality of consumption). In order to understand what we are talking about, we compare it with the situation of changes in the economic conjuncture, depending on prices in the markets of traditional energy carriers [16, 23].

Artificial intelligence and digital transformations. Digital technologies become a link between information technologies (IT), automating business preprocesses and processes of information processing, as well as operational technologies (OT), automating processes in the

production sphere [6]. Technological and digital advances are bringing disruptive and transformative change to our world that will impact on every aspect of the lives of all its citizens. Government, industry, civil society and academia are striving to anticipate how the pace and scale of these advances will change the way our world works, and to identify and leverage the opportunities and tackle the challenges they will bring. While technological and digital advances have helped to drive societal development, they have also fuelled disparities in equal rights and access to social progress, raising social, legal and ethical issues that must be addressed [16, 23].

Art education. UNESCO as part of the PERFORM consortium is in charge of the sustainability of this European Commission extra budgetary project. PERFORM aims to investigate the effects of the use of innovative science education methods based on performing arts in fostering young peoples' motivations and engagement with science, technology, engineering, and mathematics (STEM) in secondary schools in France, Spain and the United Kingdom. PERFORM takes action to overcome the remaining distance between young people and science and break the outdated unidirectional model of scientific knowledge transfer. The project explores a creative, participatory educational process through the use of scenic arts with secondary school students, their teachers and early career researchers, who get actively involved in experiencing science in a completely new way. They work with multi-disciplinary cohorts of researchers in a reflective process, exploring the history of scientific ethics and philosophy, responsible research and innovation, communication and engagement skills. PERFORM analyses how such human-centred, science-arts educational approach contributes to foster young people's motivations towards science learning (especially girls) and strengthen the transversal competences they will need for STEM careers and jobs. PERFORM works through UNESCO to translate the research results into policy briefs to Member States for widespread policy adoption beyond the three pilot countries [16, 23].

New methods for optimizing long-term economic growth. A sustainable future for all is only possible if we can balance the economic growth needed to lift millions out of poverty against the protection of the environment and the services it provides. Economic models include drivers which generate growth – such as physical and human capital, or natural resources – and modelers attempt to identify the investment decisions that will optimize the "utility" of the system. In the past, utility has been based entirely on economic costs and benefits, but to ensure sustainability, it often also includes objectives such as "environmental quality". International Institute for Applied Systems Analysis (IIASA) researchers have developed a method to analyze such models and aid us on our path to sustainable growth. Additional work focused on developing new methods for optimizing long-term economic growth models, resulting in the book Green Growth and Sustainable Development (2013). This brought together models which integrate resource and environmental constraints into economic growth models [17, 18]:

1. Comparing models to understand climate change impacts: *The Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP)*, launched in 2012, is the first to produce state-of-the-art climate impact studies with a focus on humans; *Water Futures and Solutions (WFaS*), launched in 2013, brings together 40 leading institutes to identify options for improving water security.

2. Effective policies for forest protection: *The Reducing Emissions from Deforestation and Forest Degradation (REDD)* initiative was launched by the UN Framework Convention on Climate Change and subsequently extended to REDD+, which also includes forest

conservation, sustainable management of forests, and the enhancement of forest carbon stock; A Global Biosphere Management (GLOBIOM) model.

3. Population diversity & planetary impacts models: *Socioeconomic Heterogeneity in Model Applications (SCHEMA)*, launched in 2014.

4. Integrated modeling: *The Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model* that identifies cost-effective emission control strategies to tackle air quality while reducing greenhouse gas emissions; *Global Agro-ecological Zones (GAEZ)*; *The Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP)*, launched in 2012, is the first to produce state-of-the-art climate impact studies with a focus on humans; *Water Futures and Solutions (WFaS)*, launched in 2013, brings together 40 leading institutes to identify options for improving water security.

As IIASA states such scientific initiatives help tackling global environmental challenges by focusing on a single sector or issue can lead to narrow conclusions, potentially omitting important co-benefits and/or leading to unforeseen trade-offs.

Instruments for SDGs implementation. Klingebiel & Sebastian [12] highlights the role of government departments and international organizations from different policy in managing orchestration for the SDGs as they have a number of relevant assets on which they can draw as orchestrators (financial resources, operational capacity, etc.). The orchestration of global networks might, however, stretch the existing limits of bi- and multilateral development cooperation (e.g. eligibility for official development assistance, the need to use certain implementation mechanisms).

Figure 1 shows a conceptual framework for understanding the use of long-term finance in an economy. It highlights situations in which long-term finance is preferred and in which it is not preferred, and in the case of the latter, what can be done if long-term finance is not provided in the economy [10].

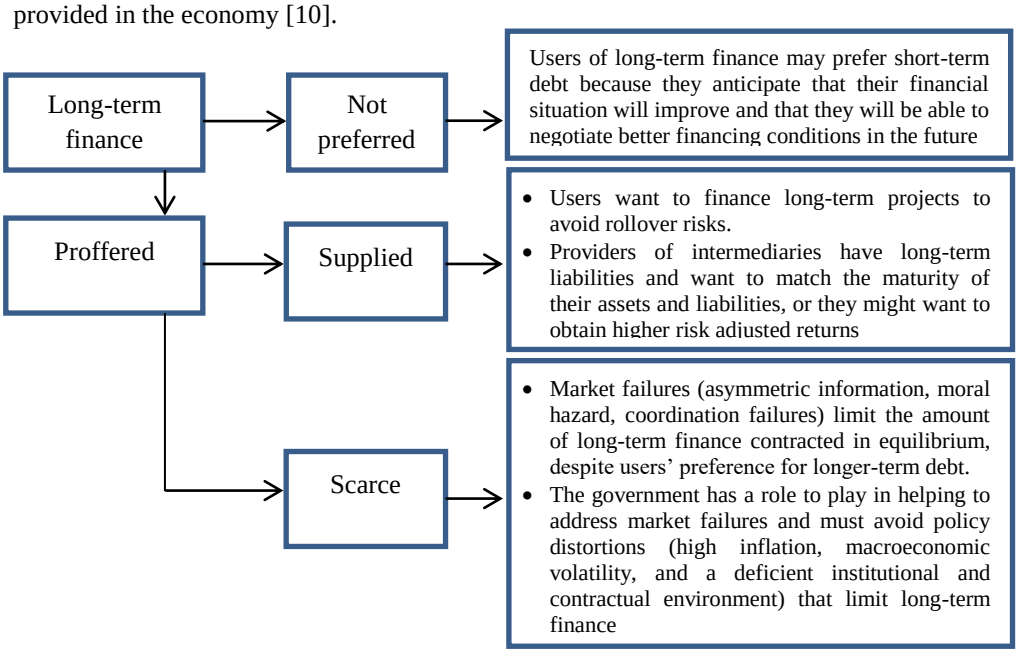

Figure 1. Conceptual Framework of Long-Term Finance [10, p. 28]

Under the motivational instruments for SDGs implementation we understand a system of administrative, environmental and socio-psychological instruments that provide an impact on individuals and societies in order to achieve the goals of transition to sustainable development. The main directions of the formation of the motivational instruments used in the practice of developed countries are presented in Table 1.

Table 1

Classification of motivational instruments for SDGs

#	Category	Content	Examples
1	Direct regulation instruments	Limit and regulate behavior on the market in terms of environmental policy	Prohibitions, procedures for knowledge and registration; ecological standards, guarantees, resource quotas; quotas on-equity; ecological registration of advertising; restriction; obligation of the consumer, etc.
2	Economic instruments	Act on the market by establishing economic incentives that should promote environmentally friendly products and act against environmentally harmful products.	Ecological taxes and tariffs on products; payments; financial assistance; market licenses; payments, transfer of ownership forms
3	Instruments for mandatory information	Oblige the producer to inform the consumer about certain environmental characteristics of the product	Mandatory ecological marking, declaration of substance content
4	Voluntary information Instruments	Provide voluntarily information about the ecological characteristics of products	Publication of environmental reports, eco-labeling of products, environmental quality marks
5	Voluntary agreements on environmentally-friendly positions	Settled up between economic entities to differentiate between different powers of interests (usually agreements between the government, and trade or manufacturing enterprises). Aimed at guaranteeing certain environmental conditions; may have more or less legitimate binding character	Signed agreements; (announcement; self-commitments)
6	Instruments for ecological protection of consumers	Includes measures of consumer unions, advisory centers; foresee consumer sanctions	Economic and moral sanctions, public pressure
7	Non-traditional institutional agreements	Increasing the sphere of responsibility of firms, establishing new relations between producers and consumers on responsibility for environmental consequences, as well as extends the very ‘product’ concept	Ecoleasing, distribution of environmental responsibility and environmental costs, formation of joint environmental funds
8	Non-traditional forms of cooperation	Establish a relationship between different agents in order to achieve bilateral benefits	Cooperation between producers and environmental organizations, between trade and environmental organizations

Implementation of successive innovative processes for ecologization of socio-economic development is possible only if the economy of the country and its structural units will be able

to form reproductive mechanisms that provide the driving force of economic processes. In this case, 'reproductive mechanism' but not a complex of measures is used, to emphasize the necessary and vital condition for the existence of a permanent restoration and continuous iteration of economic preconditions that ensure the presence of impulses and motive that are adequate to the changing social and economic situation in the country.

Conclusions. To solve endless environmental, current economic and social problems of socio-economic systems science is significant to help. It brings endless set of instruments to implement successive innovative processes for sustainable systems' development and SDGs. To reach SDGs everyone needs to do their part: governments, the private sector, civil society and people, who want to be involved to contribute to a sustainable future. The motivational instruments for SDGs implementation is a system of administrative, environmental and socio-psychological tools that provide an impact on individuals and teams in order to achieve the goals of transition to sustainable development.

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Manuscript received 12 November 2017

Экономические, экологические и социальные вызовы науки в достижении целей устойчивого развития: европейский и мировой опыт

Леонид Григорьевич Мельник**, *Александра Ивановна Каринцева, *Ирина Борисовна Дегтярева******

* *доктор экономических наук, профессор, заведующий кафедры экономики и бизнес-администрирования Сумского государственного университета, ул. Римского-Корсакова, 2, г. Сумы, 40007, Украина, тел.: 00-380-542-332223, e-mail: melnyksumy@gmail.com*

** *кандидат экономических наук, доцент, заместитель заведующего кафедры экономики и бизнес-администрирования Сумского государственного университета, ул. Римского-Корсакова, 2, г. Сумы, 40007, Украина, тел.: 00-380-542-332223, e-mail: niko_kha@ukr.net*

*** *кандидат экономических наук, доцент, доцент кафедры экономики и бизнес-администрирования Сумского государственного университета, ул. Римского-Корсакова, 2, г. Сумы, 40007, Украина, тел.: 00-380-542-332223, e-mail: irina.dehtyarova@gmail.com*

В статье анализируются экономические, экологические и социальные вызовы науки в достижении целей сестейнового развития с учетом европейского и мирового опыта. Рассматривается проблематика научных исследований трех глобальных взаимосвязанных сфер: энергетика и изменение климата, продовольственное обеспечение и вода, бедность и социальная справедливость. Анализируется проблематика научных исследований по разработке новых методов оптимизации долгосрочного экономического роста, роли науки в личностном развитии в рамках образовательного процесса, связи науки и продовольственной безопасности, развития альтернативных источников энергии, искусственного интеллекта и цифровых изменений. В статье также представлен мотивационный инструментарий для реализации целей сестейнового развития и преодоления экологических вызовов на глобальном, региональном, национальном и местном уровнях.

Ключевые слова: наука, цель сестейнового развития, система, экономический рост.

Mechanism of Economic Regulation, 2017, No 4, 9–19
ISSN 1726-8699 (print)

Економічні, екологічні та соціальні виклики науки у досягненні цілей сестейнового розвитку: європейський та світовий досвід

***Леонід Григорович Мельник*[*], *Олександра Іванівна Карінцева*[**], *Ірина Борисівна Дегтярьова*[***]**

[*] *доктор економічних наук, професор, завідувач кафедри економіки та бізнес-адміністрування Сумського державного університету,*
вул. Римського-Корсакова, 2, м. Суми, 40007, Україна,
тел.: 00-380-542-332223, e-mail: melnyksumy@gmail.com

[**] *кандидат економічних наук, доцент, заступник завідувача кафедри економіки та бізнес-адміністрування Сумського державного університету,*
ул. Римского-Корсакова, 2, г. Сумы, 40007, Украина,
тел.: 00-380-542-332223, e-mail: niko_kha@ukr.net

[***] *кандидат економічних наук, доцент, доцент кафедри економіки та бізнес-адміністрування Сумського державного університету,*
ул. Римского-Корсакова, 2, г. Сумы, 40007, Украина,
тел.: 00-380-542-332223, e-mail: irina.dehtyarova@gmail.com

У статті аналізуються економічні, екологічні та соціальні виклики науки у досягненні цілей сестейнового розвитку з урахуванням європейського та світового досвіду. Розглядається проблематика наукових досліджень трьох глобальних взаємопов'язаних сфер: енергетика та зміна клімату, продовольче забезпечення та вода, бідність та соціальна справедливість. Аналізується проблематика наукових досліджень щодо розробки нових методів оптимізації довгострокового економічного зростання, ролі науки у особистісному розвитку в рамках освітнього процесу, зв'язку науки та продовольчої безпеки, розвитку альтернативних джерел енергії, штучного інтелекту та цифрових змін. В статті також представлений мотиваційний інструментарій для реалізації цілей сестейнового розвитку та подолання екологічних викликів на глобальному, регіональному, національному та місцевому рівнях.

Ключові слова: наука, ціль сестейнового розвитку, система, економічне зростання.

JEL Codes: A13, O33, Q20, Q30, Q32 Table: *1*; Figure: *1*; References: *23*

Language of the article: English

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