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ScienceDirect

Procedia - Social and Behavioral Sciences 214 (2015) 657 – 666

Procedia
Social and Behavioral Sciences

Worldwide trends in the development of education and academic research, 15 - 18 June 2015

Professional Training of Future Green Economy Specialists and Strategic Priorities for Sustainable Subsurface Management

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Abstract

On the brink of the third millennium humanity has been showing a special interest in the environment. This article provides definitions of the term “sustainable development” and explains how to achieve it by implementing the new development model known as “the green economy”; it also shows the role and place of education in the overall set of tools and mechanisms that assist in transitioning to the green economy principles. The authors substantiate the importance and necessity of preparing specialists for the green economy as the first step towards its implementation. They give an example of an interdisciplinary training module designed to prepare future specialists. This module can easily be integrated in the student’s individual training course. We describe the advantages and benefits of the suggested educational module.

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Peer-review under responsibility of: Bulgarian Comparative Education Society (BCES), Sofia, Bulgaria & International Research Center (IRC) ‘Scientific Cooperation’, Rostov-on-Don, Russia.

Keywords: Sustainable development; strategic priorities; sustainable subsurface management; green economy; education; modular training; competitive advantage

1. Introduction

The issues of sound management of natural resources and environmental protection have formed a special set of problems humanity has faced at this stage of its development. Phrases like “environmental disaster/problem”,

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“environmental emergency” or “critical ecological situation” have become more and more common in mass media, which is the best evidence of the importance of the subject under consideration (Fig. 1).

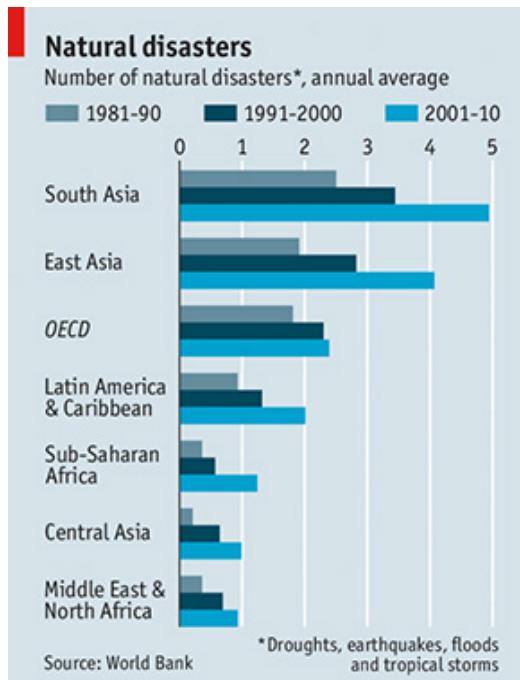


Fig. 1. Natural disasters in world regions over time (Official website of World Bank)

“Environmental problems” that people hear a lot about these days are most often caused by unsustainable and wasteful use of natural resources. In other words, man has been neglecting the needs of nature itself for a long time while using its resources as production factors. As a result, many years of consumption-driven attitude and contamination have depleted some natural resources and shattered natural ecosystems in production zones. Consequently, in many regions of the planet one can see the appearance of multiple areas suffering from excessive human pressure, when their population carrying capacity is approaching its threshold level. Given the high degree of integration in modern economy, these local phenomena, when taken together, can cause negative economic consequences on a global scale (Brown, 2003).

The importance of solving the problem of rational use of natural resources and impossibility of following the old scenario to fulfill economic activities (the existing economy) were realized, and in 1987, World Commission on Environment and Development (WCED) published a Report in which it set forth, for the first time ever, the ideas of “sustainable development”. Sustainable development is understood as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (the definition put forward by the Brundtland Commission, which is most frequently used as the basic definition in literature and regulatory documents in many countries). The main idea of the concept can be visualized in the form of balance between three elements – economy, society and environment (Fig. 2). One of the reasons making it difficult to achieve this balance is that human needs have no natural limits and they keep growing while the resources that serve to satisfy those needs are becoming more and more limited. Nevertheless, the situation is not as hopeless as it may seem at first sight.



Fig. 2. Sustainable development model (Towards a Green economy, A summary report UNEP)

One of the ways to achieve the designated balance between economy, environment and society has been described within the idea of creating a totally new approach to economic management named figuratively “a green economy”.

Because of its relatively short history the term “green economy” has no consistent definition with scientists yet. However, scientific literature most frequently quotes the definition of the United Nations Environment Program (UNEP) as a definition of choice that describes the green economy “as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (Towards a Green economy, A summary report UNEP, 2011).

The ecological requirements for sustainable development are not the only factor to determine the relevance of the task to make the economy “green”. The concept of the green economy presents an alternative development model that also offers solutions for various crises, be it financial and economic crisis, climate, food, water or fuel crises as well as the crisis of biodiversity.

The current market model has a number of system weaknesses that make our civilization more vulnerable when exposed to those crises. It encourages irrational distribution of capital in the world economy when extractive industries, the real estate sector and the financial sector receive the lion share of investment as opposed to renewable power generation, energy- and resource-efficient technologies, agriculture and protection of unexpendable resources. What happens in this situation is accumulation and active flow of physical, financial and human capital on the one hand and, at the same time, depletion of natural resources and of the capacity of natural ecosystems on the other hand (Ignatyeva, 2011).

It is worth noting that the concept of green economy does not replace the concept of sustainable development but elaborates it significantly and develops it further; most scientists believe that sustainability largely depends on setting up the right economy.

The question “How can we accomplish the transition from the existing and familiar brown economy to the green economy – the right one?” is fundamental when considering mechanisms and methods of implementing this transition (Bobylev & Zakharov, 2012). The transition itself can be realized through the following approaches: economic approach (generally, the tools are based on market incentive mechanisms); administrative approach (through direct regulation, usually performed by the state with the help of administrative methods) and combined approach (a combination of the first two approaches) (Fig. 3).

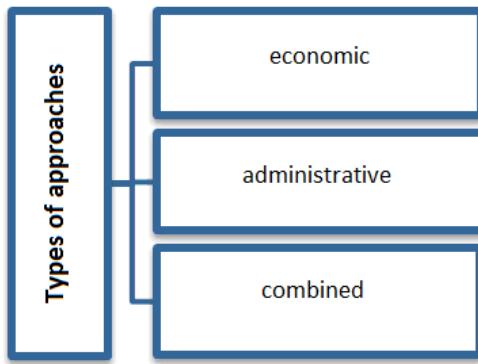


Fig. 3. Types of approaches to implement the tools of a green economy (Bobylev & Zakharov, 2012)

We believe the combined approach to be the most effective of the three, as it does not limit us to just one impact area, but allows to use all available tools and combine their strong points effectively.

Besides, we believe that implementation of any economic or regulatory measures should be accompanied by measures taken to enforce the values of the green economy through social institutes. These institutes will help create a proper environment enabling a more effective transition to the green economy and achievement of sustainable development. Obviously, the idea of the green economy, much like a weak sprout, will not be able to establish itself in the aggressive environment of the existing economy if no enabling conditions are created.

Education may become one of the ways to create the necessary conditions.

2. “Green economy and education” tandem in the context of sustainable development

We share the belief that education as a social institute is the most important of the main tools that help to perform transition to the green economy. It helps support and disseminate innovations in technology, economics, social and cultural spheres. It is the ability of the society to generate new ideas and approaches to solving problems as well as the opportunity to demonstrate the effectiveness of these innovations and to implement them on a large scale that will guarantee the competitive advantage for national economies in the future.

The “green” sectors will need new workplaces. In most professions, the demand for new skills will grow, too. In order to solve this task the systems of education and professional training will need to provide well-trained and highly qualified personnel, especially for the sectors related to energy efficiency and use of renewable energy (Official website of the Federal State Statistics Service of the Russian Federation).

2.1. Preparing specialists in energy efficiency – the prospects

Besides, education can not only supply the job market with new specialists for the green economy but it can also provide retraining of some existing specialists. As the “green” spheres in the job market develop, the demand for specialists in new professions known as “the green collars” grows, too.

Specialists in the sphere of the rapidly developing policy of energy efficiency and energy savings could be an example of such “green collars” (The European Centre for the Development of Vocational Training). In particular, energy management is a key point in making any sector of economy “greener”, since none can do without using energy in one way or another.

Currently there is a shortage of specialists in “green” areas of economy, for example, in bio-fuel production in Brazil, in the renewable power generation and production of eco-goods and technologies sectors in Germany, the USA and Bangladesh, in the construction sector in Australia, China, Europe and South Africa (Ignatyeva, 2011).

Apart from specific qualifications and competencies, needed for the sector of eco-friendly goods and services, it is equally important to make all human capital “green” in all sectors and on all levels.

By and large, if we speak about the content, approaches and methods of education, the education aimed at the

green economy is, above all, aimed at changes because the transition to sustainable development and green economy requires to abandon outdated forms of conducting business, to change the rules – both formal (state policy, legislation) and informal (business ethics, social norms and moral values). In the new conditions, education should be effective in preparing creative and self-motivated personalities who are able to be innovative and flexible in solving complicated problems. To this end, we need first to move from reproductive to creative approach, both in organizing the educational system and educational process, and in the content and methods of teaching.

2.2. Preparing specialists for the green economy in the context of Russian education –situation, trends and prospects

Over the last few years Russia has seen growing expenditures on environmental protection allocated from the state budget (Fig. 4), which testifies to mainstreaming the environmental policy. This is also evidenced by growing financial stimulation of environmental events, creation of new and enhancement of existing regulatory documents, as well as by ratification of a number of new important environmental documents (the Kyoto Protocol, the Climate doctrine, the Law “On energy saving”, the basis of the ecological policy of the country for the period till 2030 etc.).

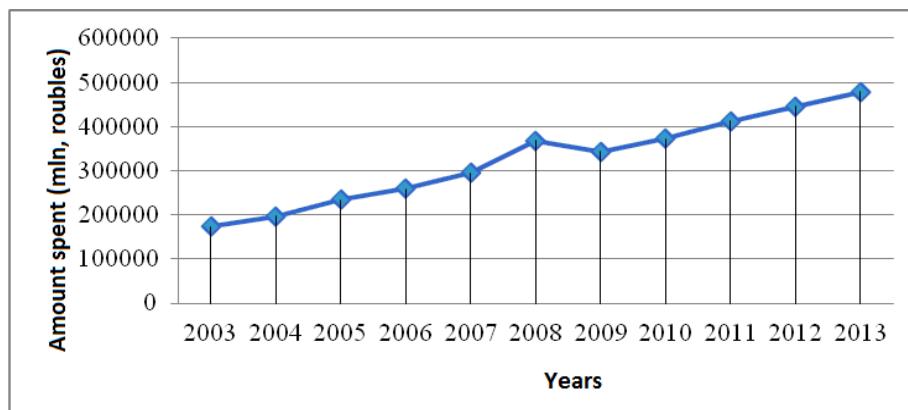


Fig. 4. Expenditures on environmental protection in the Russian Federation (Official website of the Federal State Statistics Service of the Russian Federation)

This situation in ecological policy as well as orderly refocusing of the production in Russia on energy saving and on minimizing pressure on the environment have naturally triggered response on the part of the job market and of the education market, too. Both are interested in future green economy specialists.

For instance, the Ural Federal University named after Russia's first President Boris Yeltsin (UrFU) envisages its participation in the new industrialization of the Russian economy in four groundbreaking spheres, including:

1. Information technologies and man in the information society;
2. Flexible technologies and new materials;
3. Living systems and health;
4. Power generation, resource saving and rational nature management.

As you can see from this list, the UrFU has foreseen the need to prepare specialists in green economy, too. That is why we believe it to be appropriate to create a new educational product, aligned with the times and the economic situation in modern Russia.

Our approach to preparing the workforce for the green economy is based on the development and implementation of a competitive educational module that would be fundamentally new for the Russian education. The aim of this educational product is to provide a comprehensive training in the spheres of energy/environment/economics to prepare highly qualified specialists who would be in charge of rational nature management and environmental safety problems solving.

The suggested module is expected to be delivered within existing Bachelor and Master's programs in the Ural

Federal University named after Boris Yeltsin. This study course has its competitive advantages. These are its interdisciplinary and inter-institutional nature, which implies a buy-in from UrFU's academic teaching staff and possibly from the teaching personnel from industry-specific higher education institutions (for certain disciplines) as well as from experts from enterprises having practical experience in using "green" technologies, including those from abroad. Hands-on training (on-the-job-training, field trips, participation in specialized exhibitions and conferences) is to be arranged at operative "green" factories. Besides, students in the Master's program will have to attend academic exhibitions together with their teachers. The students are expected to participate in sessions with foreign delegations arranged by the Ural Chamber of Commerce and Industry (related to the subject of the study course), participate in international forums and in meetings held within the framework of the international policy pursued by the UrFU with the BRICS countries.

The green economy as an alternative to the existing economy is considered by the countries virtually on all continents: in China, Taiwan, South Korea, Japan, India, Brazil, Argentina, Canada, the USA, the European Union countries, Australia, New Zealand, Iceland, South Africa, Bangladesh, Malaysia, Thailand and many others, as well as in Russia, the Republic of Kazakhstan and the Republic of Belarus.

Given the global situation, Russia will have to diversify its economy towards the technology intensive green economy earlier (preferred) or later.

The relevance of the suggested study course is also supported by the fact that in Russia science and education still lag behind practice – they lag behind business that is successfully using "green" technologies.

Introducing this study course will allow to draw up the concept (strategy) of energy-efficient green economy in Russia's federal districts and regions. This will give an opportunity to form a cohort of qualified specialists in green economy for different business sectors in the nearest future.

Studying this course within their main Master's program will allow students to work – upon graduation – within their specialty and have knowledge in green economy, which will make them more competitive in the job market and give more opportunities for their career advancement.

This study course shall also help improve the image of Russian higher education institutions and enhance the prestige of the Russian education.

3. Advancing the green economy – methodology and methodological novelty of the task

Given its interdisciplinary and inter-institutional nature and low degree of approbation, this study course is expected to be delivered by UrFU's academic teaching staff and possibly by the teaching personnel from industry-specific higher education institutions (for certain disciplines) as well as by experts from enterprises having practical experience in using "green" technologies, including those from abroad. Young scientists out of graduate and post-graduate students and external doctoral candidates are expected to contribute as the teaching staff, too.

The suggested methods of presenting the material will provide viability and fundamental strength of the study course, as well as maximum benefit from applying the knowledge that the students will be able to use in their work within their specialty upon receiving a Master's degree, or when finding a good job in a "green" business.

The tutorial novelty of the study course in question lies in its unique nature; nothing of the kind is run in Russian higher education institutions. Working specialists as well as teaching staff from abroad can be invited to conduct certain classes or deliver lectures.

Introducing this innovative study course in green economy will contribute to a gradual integration and approbation of the course within the existing Master's program with a possibility to create a separate Master's program in the future.

Preparation and realization of the suggested study course will include pooling the data about specialists, technologies, products and services, productions, regulatory and legal framework and other initiatives pertaining to the green economy; also, it will include reviewing the collected data related to the green economy.

The Ural Federal University named after President Yeltsin has excellent facilities and resources necessary to properly realize the suggested study course, including its realization as a distance-learning course for other regions and countries.

The study module suggested for development is a separate course/module based on several academic subject areas, such as economics of nature use, managerial economics, innovation management, "green" technologies etc.

The study course consists of separate topics.

Due to its innovative and interdisciplinary character, this study course can be delivered to graduate students studying energy efficiency, eco-management, ecological safety and economic security and it can be delivered within the variable part of the course or within an optional part from other Master's programs chosen by the student.

The study course under consideration fully complies with the requirements of the educational standard of the higher education institutions and with those of the Federal State Educational Standard of the third generation. It envisages the development of the ability in students to generalize and review the results as part of their professional and cultural competencies.

The study course is going to be unique in terms of content:

- for the first time ever the study course in green economy will take the form of a comprehensive and structured academic subject area;
- it envisages the creation of the student's personal account within a single electronic platform storing the necessary teaching information.

Thus, the suggested course is concordant and fits in with many educational programs and gives an opportunity to improve and deepen the knowledge, skills and competencies needed for successful professional engagement and carrying out thorough research in energy-efficient green economy.

The green economy as a separate academic subject area is intended to form cultural competencies, such as:

- ability to develop one's creative, cultural and professional potential and master new methods of research through one's individual effort;
- ability to gain and use new knowledge and skills pertaining to different topics of the study course with no outside help;
- ability to make organizational and managerial decisions and assess their consequences; and professional competencies, such as:
- ability to generalize and review the results received by local and foreign researchers, identify and define acute scientific problems;
- ability to make independent research within the framework of the studied course;
- ability to present the results of the research in the form of a research project report, an article or a presentation;
- ability to develop an algorithm of using various tools for managing the green economy;
- ability to substantiate the decisions made in the area of green economy management;
- ability to analyze and assess the degree of ecological and economic safety of an area;
- ability to master theory and methods of research in the area of low-carbon, green economy management;
- unite not only students, graduate students, post-graduate students as those studying humanitarian subjects, but also economists and engineers.

New approaches in education and science blend perfectly, as it is seen in teaching the green economy and the latest scientific research in ecologically sustainable subsurface management.

4. Strategic priorities and indicators of ecologically sustainable subsurface management

Ecologically sustainable subsurface management means social, economic and technological development of the extractive industry in compliance with the laws of biosphere (Timofeyev-Resovsky, Yablokov, Glotov, 1973) and ecological restrictions; it includes the problem of industrial waste landfills known as technogenic deposits. That is why the strategic priorities for the development of subsurface resources usage are ranked in the following clearly defined order:

- ecological;
- social;
- and, finally, economic.

The leading role of the ecological aspect is determined by the following:

- when there is no natural (biological) base, there are no grounds left to raise the issue of sustainable development of the territory;

- there are fewer obvious methods in other areas (in economics and sociology), while the biological aspect allows to define the boundaries of the ecological “corridor” limiting the development of subsurface resources use;
- specifications of this “corridor” are determined fairly objectively and substantially; this is done with the help of energy flows (biogenic elements) in natural and anthropogenic channels.

The theory of biotical regulation in a natural habitat serves the scientific fundamental basis for the concept of sustainable subsurface management.

Indicators of ecologically sustainable subsurface management are those that describe the change of a natural habitat, the social sphere and economics over time; these indicators provide a qualitative and quantitative characteristic of the subsurface management problem (Vernadsky, 1965).

Generally, the accepted indicator systems are ranked according to their popularity and importance for certain spheres of natural resources use. Their popularity is based on the status of the developers (UN Commission on Sustainable Development, World Bank, European Union and others). The importance of existing indicator systems is determined by the fields of knowledge and by developers: economics, biology, environmental protection, sociology. The remarkable thing is that popular and industry-based (subjective) importance of the indicators often fails to reflect concept-based principles of sustainable development (Rio+20; Johannesburg—2002; Rio+20).

The majority of existing sets of indicators of sustainable nature management do not provide a comprehensive picture, they are poorly related to each other and they do not suggest any priorities. Thus, the characteristics of subsurface management are usually limited to geological data and technological parameters.

In the system of strategic priorities and indicators for subsurface management the top priority is given to assessing the condition of natural eco-systems in the area of subsurface use:

- the actual share of natural eco-systems;
- the required share of natural eco-systems;
- the rate of reduction or recovery of eco-systems.

These three indicators characterize the condition of the territory and the degree to which the sustainability of subsurface management has been achieved. The indicator showing public consumption of clean primary products from the environment has the same high priority.

Table 1 shows the distribution of land areas in mid-Urals based on the degree of their preservation or non-preservation.

Sustainable development of the biosphere means that man should extract no more than 1 or 2% (Gorshkov, 1995) of “clean primary products” from the biosphere, which corresponds to maximum 10% (Danilov-Danilyan & Losev, 2000) “disturbedness” of the territories; according to the data in Table 1, sustainable development is in place only in two northern areas of the region.

The set of indicators that describes the social aspect also includes such well-known indices as Human Development Index, Adjusted Net Savings, Knowledge Economy Index, Composite Stability Index and others. In the northern areas that are actively developed, and in old industrial regions, there appear factors (indigenous peoples, accumulated environmental harm) that were not previously known and are poorly considered by traditional indicators.

Table 1. Distribution of land areas in Sverdlovsk region based on their preservation or disturbed character (2013)

Cadastral forest area	Undisturbed land (land with native forest types), %	Partially disturbed land (cropland, land with secondary forest growth), %	Disturbed land, % (human settlements, industrial land)
1. Ivdel'-Ussk area	27.6	67.7	4.7
2. Serov area	24.2	67.3	8.5
3. Tavdinsk area	19.3	68.8	11.9
4. Novaya-Lyalya area	14.8	71.5	13.7
5. Nizhny-Tagil area	12.7	68.9	18.4
6. Alapaevsk area	15.8	66.6	17.6
7. Turinsk area	14.4	71.2	14.5
8. Krasnoufimsk-Shalya area	8.1	60.0	31.9
9. Yekaterinburg area	17.2	55.2	24
10. Near Pyshminsk area	7.4	62.8	28
Total in the region:	16.8	60.9	22.3

The absence of a comprehensive solution to ecological, economic and social problems in the subsurface management in the Urals, as well as things like reduced volumes of extraction of subsurface resources, a decrease in the number of people in production, an advance of accumulated environmental harm in the territories of subsurface use all lead to the deterioration of public health. Table 2 describes the situation with the public health in large areas of subsurface management in Sverdlovsk region.

Table 2. Crude and primary mental disease incidence in the areas of subsurface management in mid-Urals (calculated for 100,000 of population)

Municipalities	Crude incidence			Primary disease incidence		
	2008	2009	2010	2008	2009	2010
Town of Asbest	1884	3254	-	335	347	-
Town of Kachkanar	1477	1782	1898	72	477	393
Town of Kushva (Nizhny Tagil)	2801	1777	1873	331	411	524
Town of Rezh	3986	3271	2601	469	416	461

We need a comprehensive solution to ecological, economic and social problems in subsurface management; the social situation in the areas of subsurface resources extraction cannot be improved but for a comprehensive approach.

Social indicators for the subsurface management sphere include Constitutional indicators that characterize the regulatory basis of the subsurface use. These are the indicators that helped solve social, ecological and economic problems in the coal industry in Poland. In the 90-ies of the 20th century, they helped adjust the volumes of coal extraction, solve the problems of ecological safety of coal pits and settle the issue of employment of the population in this industry. A similar comprehensive approach has been used in Spain.

Indicators describing environmental pollution have a lower priority due to their local character; they reflect the condition of separate territories.

The current tendency to increase spending on environmental protection without making the economy more ecological (without including ecological consequences of business activities in the sphere of economy) fails to make the air, water, soil and territories in the Urals better.

The set of economic indicators is the last one in assessing ecological sustainability of the subsurface management. Economic indicators of the highest priority are the following: comprehensive (social, ecological and economic) assessment of natural resources, assessment of environment-forming potential of the territories with subsurface management, assessment of social importance, comprehensive (social, ecological and economic) assessment of the restrictions and limits in using natural resources, assessment of measuring natural and production potentials against each other. The indicators for complex use of natural deposits and handling of technogenic deposits are meant, in the first place, to identify the discrepancy between the conceptual goal and local conditions, to assess this discrepancy and to provide rationale for the actions needed to achieve sustainable development of the Urals.

Next on the priority scale there are economic indicators of cost of natural assets, natural capital and environmental services in the economic sphere and production and consumption indicators.

Traditional economic indicators of “rational nature management” and “environmental protection” stand lower on the priority scale.

All indicators of sustainable development of subsurface management described herewith are consistent with the international concept of environmental safety and are based on international standards.

5. Conclusion

Currently, the world pays close attention to sustainable development, and the issue of green economy development has become topical on a global scale. Consequently, the demand for specialists in green economy is expected to grow in the future.

In particular, the Russian government has recently adopted a great number of regulatory acts intended to provide sustainable development of the country. This important and necessary task cannot be fulfilled without using green economy as the tool for sustainable development. That is why preparation of highly qualified specialists in low-

carbon management/ low-carbon green economy has never been more urgent.

It is important to note that, currently, the Russian economy can be streamlined by Russian specialists alone. Besides, preparing our own national specialists has always been a priority for our country. For this very reason, there is a burning need in the Russian Federation to prepare our own highly skilled experts in green economy. Over time, this need will grow more obvious.

The suggested system of strategic priorities and indicators of sustainable subsurface management has the following features:

- it has a fundamental scientific base, which is biotical regulation – the living base for the Earth;
- it is comprehensive and its comprehensive character is defined by conceptual, ideological, political and economic levels of sustainable development of subsurface management regions and by the need for a comprehensive approach to solving sustainable development tasks that was offered at the “Rio+20” Forum;
- it has clear priorities; here, regional environmental protection programs and rational subsurface management programs are implemented solely upon compliance with the “corridors” for the acceptable economic activity, which are the limits for extracting natural resources;
- it is based on interrelated ecological, economic and social factors that allow to take into account biotical regulation – the living base for the surrounding world – in well-known integral indices such as Human Development Index, Adjusted Net Savings, Knowledge Economy Index, Composite Stability Index and others;
- it reflects the dynamic development (over time and space) of natural eco-systems, externalities in business operations economy, balance (disagreements, conflicts) of interests between individual natural resources users and public preferences.

Acknowledgements

The article has been prepared with support and as a part of the grant from Russian Science Support Foundation No. 14-18-00564.

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