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Economy and Ecology: Contemporary trends and contradictions

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Part I - POLUTION AND ENVIRONMENTAL PROTECTION

Spatial and Specific Variance in Accumulation of Heavy Metals in Tree Vegetation of Moscow City South-Western Administrative District

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Abstract

Research of Moscow residential and transportation landscapes was performed in 2018. Examined parameters included spatial and specific variance of Zn, Pb, Cu, Cd, and Cr accumulation by small-leaved linden (Tilia cordata), ash-leaved maple (Acer negundo), and hard maple (Acer saccharum). Non-uniform spatial distribution of heavy metals in tree leaves was determined, depending upon tree species, and location of the trees. Areas with top total concentrations of pollutants were located along the motorways with extensive traffic, and in industrial zones. It was found that zinc is the prevailing biogenic element within the examined spectrum. For Tilia cordata it comprises close to 77%, for Acer negundo – close to 80%, and for Acer saccharum – from 66% to 80% of the determined pollutants' content. At the same time the share of copper varies within the 16-20% range. Increasing pressure causes anomalous changes in chemical composition of the plants, both in terms of biogenes, and polluting elements. That was demonstrated using an example of an ash-leaved maple growing in a 23rd public garden of Novye Cheremushki, and hard maple growing in 5 meters from a motorway. Specific property of tree foliage in city environment is high pollutant accumulation capacity. Top summary pollutant concentration coefficients in tree foliage were determined for the most heavily polluted areas. At the same time the content of heavy metals in leaves at some sites differed for Cu by a factor of 2, for Cr – 4, Zn – 14, Cd – 42, and Pb – 45.

Keywords: pollution, heavy metals, tree vegetation, accumulation, metals association, city landscapes.

1. INTRODUCTION

Soil pollution with heavy metals is a common problem for industrial centers and urban territories all over the world (Yang et al., 2018; Cai et al., 2019; Stepanova et al., 2018; Kaur et al., 2018; Jafari et al., 2018; Sawut et al., 2018; Ma et al., 2018; Li et al., 2018; Gabarrón et al., 2017; Peng et al., 2017).

Soils of the city of Moscow are subject to increased anthropogenic pressure that damages ecological functions of these soils, namely processing of organic residue, atmosphere and surface water cleansing, forming microclimate, topsoil fixation, and support of biological and geological cycles of matter (Zubkova et al., 2018). Today Moscow is among the largest actively developing global megalopoli, where up to 90% of emissions to atmosphere are due to vehicle exhaust fumes.

Air pollution and adverse soil status (salination, compaction, and heavy metals pollution) are key adverse factors for trees in city environment. Taking these factors into account is essential for sustainable development of cityscape diversity (Egorov et al., 2018).

Wide spread of pollution with heavy metals in city soils requires understanding of special specifics about heavy metals transfer patterns within plants. Key mechanisms include exclusion, passive, and active accumulation. These mechanisms are known for a very limited number of tree species. Other independent from soil sources of pollution for trees growing in the cities can include hard particles and atmospheric substances. Metals in the air can get immediately into fruits, or be sucked through stomata, and transfer later (Gori et al., 2019).

For most metals content increases with leaf age, causing remobilization of the metals from soil, then metals return to topsoil (Almahasheer et al., 2018).

Barrier functions play an important role in the input of heavy metals into plant organs. For example, excessive concentrations of zinc and copper in soils affected city trees - accumulation of heavy metals in their accumulation apparatus is higher than one for the trees growing at reference sites

(Voskresenskiy et al., 2017). At the same time maximum permitted concentrations for tree leaves and needles is not specified, which demonstrates plant root system barrier function.

Protective reaction of P. alba berolinensis leaves with regard to Pb stress depend upon both concentration of Pb, and exposure duration, and Pb concentration level in soil equal to 300 mg/kg causes strongest protective reaction of poplar plantings, substantially exceeding reactions displayed at higher concentrations equal to 500 and 700 mg / kg (Jiang et al., 2018).

Plants (Arundo donax, Broussonetia papyrifera, Robinia pseudoacacia and Cryptomeria fortunei), planted directly into zinc melting slag, substantially increase accumulation of nutrients, and decreased bioaccessibility of heavy metals (Cu, Zn, and Cd), except for A. done regarding Zn and Cd. These trees display high resistivity to heavy metals, and their low accumulation (Luo et al., 2019).

Research by Woch (2018) demonstrated that in case of very complex and productive ecosuystems, even under heavy pollution with heavy metals hey role belongs to biotic factors. Despite high content of heavy metals, namely, Cd, Pb, and Zn, in soils, key factor affecting differences in undergrowth phytocenosis was tree canopy shade density. Specied composition changes substantially with increase of coverage of trees, stress-resistant specied became more common. Cd to Ca ratio caused decrease in the number of trees and endangered species.

Results obtained by Wang et al., (2019) demonstrated that the presence of root system changes distribution and interaction of Cd and Cu in plant organs and increases plant tolerance and phytoextraction capabilities. Initial sprigs can incept and accumulate heavy metals at early stages of willow growth without roots. Cu inhibited Cd inception and accumulation by the plants and facilitated Cd transfer. In turn, Cd inhibited Cu-inception of the root system.

Similar position of Cd and Pb in the row of heavy metals accumulation in soils and plants was demonstrated. These metals were usually efficiently transported from roots to shoots. Metals were distributed within the plants according to plant life form, higher levels were present in perennial plants, for example, concentrations in wood matter of S. polaris, D. octopetala, D. corymbosa, were higher than in redivives (Hanaka et al., 2019).

Therefore, knowledge of the laws of heavy metals accumulation by different tree species can become basis for city landscape design and management.

Research goal was to determine spatial and specific heavy metals accumulation by trees growing in the South-Western administrative district of Moscow.

2. RESEARCH METHODS

Research took place in residential and transport city landscapes in 2018 and included testing of the most common tree species - small-leaved linden, ash-leaved maple, and hard maple. Sampling sites included Academic Glushko street, 12 (1); northern side of Moscow beltway, 35 km waypoint (2); Koktebelskaya street, 8 (3); General Tyulenev street, 5, bldg. 1 (4); 23rd public garden of Novye Cheremushki (5), Profsoyuznaya street, 43 (6); and Profsoyuznaya street, (7). The sites were selected as the ones being part of complex research related to studying environmental effects of deicing reagents (Zubkova et al., 2018).

Samples were taken in early September. At each site three tree leaf samples were taken; total number of samples was equal to nine for each species. Sampling method was due to presence a single trees at sampling sites.

Leaves were collected at the end of vegetation period, washed with distilled water, dried and then incinerated. Total contend of heavy metals was determined using atomic absorption method in the lab of Moskovskiy Federal State Budgetary Institution – State Agrochemical Service Center.

In order to perform environmental and geochemical assessment, pollutants concentration coefficient (Kc) was determined using formula:

$Kc = Ci:Cф$, where Ci is actual analyte content, and Cф – reference analyte content. A minimum value from the obtained range was used as reference concentration. In order to describe pollution, impact the total pollution value (Zc) was used, determined using a formula:

$Zc = \sum (Kci + ... + Kcn) - (n - 1)$, where Kci is a concentration coefficient for i-th pollutant, and n – is the number of pollutants.

Statistical processing of analytical data was performed using Statistica 6 software.

3. RESULTS AND DISCUSSION

Based on research results it is possible to state that there is a non-uniform spatial distribution of heavy metals in tree leaves. Distribution is affected by tree species and location of the trees (Table 1).

Table 1 – Content of heavy metals in the leaves of different tree species, mg/kg

Site	Tree species	Zn	Pb	Cu	Cd	Cr
1	Tilia cordata	30.8 ± 6.5	0.64 ± 0.22	8.1 ± 1.9	0.081 ± 0.028	0.31 ± 0.02
2	Tilia cordata	34.3 ± 7.2	0.67 ± 0.23	8.7 ± 2.0	0.037 ± 0.013	0.85 ± 0.08
3	Acer negundo	31.3 ± 6.6	0.21 ± 0.07	6.6 ± 1.5	0.044 ± 0.015	0.69 ± 0.07
4	Acer negundo	31.3 ± 6.6	0.71 ± 0.25	5.9 ± 1.4	0.069 ± 0.024	0.88 ± 0.07
5	Acer negundo	370.0 ± 55.0	1.82 ± 0.64	8.6 ± 2.0	1.542 ± 0.540	1.24 ± 0.1
6	Acer saccharum	27.0 ± 5.7	0.43 ± 0.15	6.7 ± 1.5	0.081 ± 0.028	0.43 ± 0.02
7	Acer saccharum	32.8 ± 6.9	9.47 ± 3.31	5.5 ± 1.3	0.846 ± 0.296	1.08 ± 0.10

Accumulation row for the examined elements was the following: - Zn > Cu > Pb (Cr) > Cd. It is necessary to note that widest variation of pollutant contents for single species was displayed by Tilia cordate about cadmium and chrome (2.2 and 2.7 times, correspondingly).

Anomalous content of all pollutants was revealed in Acer negundo leaves from the 23rd park of Novye Cheremushki (site 5), and hard maples, growing on Profsoyuznaya street display severe differences in elements content - for lead by a factor of 22, for cadmium – by a factor of 10, and for chrome – by a factor exceeding 2. One of the reasons for that is the distance from a motorway (5 and 40 meters).

While comparing summary pollution coefficients, is necessary to point out that differences in accumulative capacity of the trees depend upon their species and location.

For example, for ash-leaved maples growing in three different places total concentration of pollutants differed by a factor of 22 and more. It can be also noted that sites with maximum total coefficients of pollutant concentration are located close to major roads with intensive traffic and industrial zones (table 2).

Table 2 – Heavy metals concentration coefficients for tree leaves of different species

Pollutant	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Zn	1.14	1.27	1.16	1.16	13.70	1.00	1.21
Pb	3.05	3.19	1.00	3.38	8.67	2.05	45.10
Cu	1.72	1.85	1.40	1.26	1.83	1.43	1.17
Cd	2.19	1.00	1.19	1.86	41.68	2.19	22.86
Cr	1.00	2.74	2.23	2.84	4.00	1.39	3.48
∑C	5.10	6.05	2.98	6.50	65.88	4.05	69.83

From the data different associations of heavy metals were accumulated in the examined leaf samples, depending upon the species and functional zone where trees grow. Forexample, leaves of Tilia cordata growing in industrial and residential areas lead concentration values exceed ones for chrome and cadmium. At the same time in industrial zones concentration of chrome in Tilia cordata leaves is higher than in residential areas. Anotrher imporatnt factor is distacnce from the roads. Samples of Acer saccharum colleced at the disctances of 5 and 40 meters from the road displayed different concentrations of analytes.

Another important factoir of assessing environmental and geochemical parameters of ecosystemsis an accumulation coefficeint of accumulative index (Ki) clculatyed as a ratio of element content in dry mass of plant leaves to the content of element acid-soluble form in soil (mg/kg): Ki = Cp:Ci, where Cp – is the average contents of an i-th element in leaves, mg/kg; Ci – average soil content of an i-th element, mg/kg (see Table 3).

Table 3 – Heavy metals bioaccumulation coefficients for tree leaves

Sampling site	Zn	Pb	Cu	Cd	Cr
1	0.52	0.07	0.38	0.08	0.02
2	0.31	0.04	0.44	0.93	0.06
3	0.48	0.03	0.53	4.40	0.06
4	0.52	0.04	0.47	6.90	0.09
5	31.7	0.46	1.84	20.05	0.17
6	2.25	0.10	1.03	0.81	0.05
7	0.39	1.05	0.10	1.41	0.06

Depending on the key sources of heavy metals for the trees different accosiations of heavy metals can form at different sites, but the main role is played by the ratio of element contents which is usually genetically determined. Table 4 contains presence of examined elements for different polant specied growing under different antropogenic pressures.

Table 4 – Content of heavy metal pollutants in leaves of different tree species (percent)

Sampling site	Tree species	Zn	Pb	Cu	Cd	Cr
1	Tilia cordata	77.1	1.6	20.3	0.2	0.8
2	Tilia cordata	77.0	1.5	19.5	0.1	1.9
3	Acer negundo	80.6	0.5	17.0	0.1	1.8
4	Acer negundo	80.5	1.8	15.2	0.2	2.3
5	Acer negundo	96.6	0.5	2.2	0.4	0.3
6	Acer saccharum	77.9	1.2	19.4	0.2	1.3
7	Acer saccharum	66.0	19.0	11.1	1.7	2.2

Zink prevails in the overall composition of examined element. This biogenic comprises close to 70% of heavy metal pollutants for Tilia cordata, close to 80% for Acer negundo, and 66-80% in Acer saccharum. Chemical composition of the plants changes under increased environmental pressure, and this process causes both changes in ratios of biogenic elements, and pollutants. This point is illustrated by results obtained for Acer negundo thee growing in the 23rd part of Novye Cheremushki district, and Acer saccharum growing 5 meters away from a motorway.

Thus, distinctive feature of tree leaves in urban environments is a high pollutants accumulation capacity. Highest total pollutant concentration coefficients were determined for leaves from trees growing in the most polluted areas. At the same time at some sites the content of heavy metals in leaves varied for Cu by a factor of 2, Cr – 4, Zn – 14, Cd – 42, and Pb – 45.

Study of leaves' chemical composition can assist in making optimal decisions in terms of species and location of trees used for greening the city of Moscow.

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Photosynthetic Activity of Plants and Dynamics of Growth Process in Soil Contaminated by Cadmium

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Abstract

The article presents the results of field studies on the effect of different doses of cadmium on the assimilating leaf area, photosynthetic potential, its change as the area of the leaf surface formed in a interfacial period, and the duration of the interfacial period. The introduction of cadmium in a dose of 10 mg/kg of soil had a negative impact on the increase in the vegetation phases and on the accumulation of the total potato biomass by the end of the vegetation. At the same time, the output of the obtained products per 1000 units of photosynthetic potential decreased by 0.24 kg of tubers compared to the background version. On average, for 2 years of research, the maximum value of leaf productivity was observed at a dose of cadmium 1 mg/kg, which is most likely due not to the biological need for it, but to stimulating intoxication.

Keywords: heavy metals, cadmium, photosynthetic potential, net photosynthetic productivity, leaf productivity.

1. INTRODUCTION

Heavy metals are one of the priority pollutants of air, soil and water bodies on a global and regional scale, which is largely due to their biological activity [9,14]. They are stable in the environment, can accumulate in the tissues of living organisms and be transmitted through food chains [11].

Getting in different ways in the atmosphere and soil, TM come first in plants, and then – in the human body and animals.

It is believed that from 60 to 90% of all trace elements humans and animals receive from plant food, so it is no exaggeration to talk about the chemical composition of plant products as a factor determining the health of mankind as a whole [6, 7].

It should be noted that the plants themselves absorb heavy metals selectively, having a certain protective system in relation to the toxicants. At the same time, there is an uneven distribution of chemical elements in plant organs [15,17].

Among TM, one of the most mobile elements is Cd, some of which enters the cell cytoplasm and can have multiple toxic effects on the metabolism of both producers and consulates [8,9]. In areas of high content of cadmium in the soil is set 20-30 times the increase in its concentration in the ground parts of plants compared with plants unpolluted areas. It is not among the elements necessary for plants but is effectively absorbed by them. Cadmium is mainly localized in the roots and in smaller quantities - in the stems, petioles and main veins of the leaves. At the same time, when the amount of cadmium in the medium rises sharply, the concentration of the element in the roots is several times higher than its concentration in the above-ground mass. It was found that chlorophyll can concentrate cadmium in plant tissues [2,3,13]. Visible symptoms caused by increased cadmium content in plants are chlorosis of leaves, red brown colour of their edges and veins, as well as growth retardation and damage to the root system. Cadmium phytotoxicity is also manifested in inhibitory effect on photosynthesis, violation of carbon dioxide transpiration and fixation, as well as changes in cell membrane permeability [12,17].

Contaminated plants may contain up to 400mg/kg Cd or more. In contrast to other mineral elements (except Zn), Cd can accumulate in relatively large amounts in generative organs. The high phytotoxicity of Cd is explained by its proximity in chemical properties to Zn. Therefore, the Cd can play the role of Zn in many biochemical processes, interfering with the operation of vital enzymes such as carbonic anhydrase, various dehydrogenases, phosphatases and proteases and peptidases involved in protein metabolism, enzymes of nucleic acid metabolism, and others. As a chemical

analogue of zinc, cadmium can replace it in an enzymatic system, required to fosforilirovanija of glucose and the accompanying process of formation and breakdown of carbohydrates [16,19].

Due to the increasing flow of heavy metals (HM) into the soil, it became necessary to normalize their content, that is, to establish limits beyond which pollution is unacceptable. A special role is given to the study of the accumulation of pollutants in agricultural plants. It is an important link of ecological and biogeochemical studies related to the study of the evolutionarily formed potential of resistance of plant organisms to various doses of heavy metals; the influence of the latter on the productivity of phylogeneses, activation of the photosynthetic apparatus, the identification of agricultural plants with high resistance to environmental stress [4,8].

The purpose of our research was to study the effect of different levels of soil contamination with cadmium on the performance of the sheet metal and the productivity of *Solanum tuberosum.*

2. METHODS

The research methodology is based on the concept of critical loads, considered as biogeochemical standards for assessing the permissible anthropogenic impact on ecosystems of different levels. In particular, the selection of environmental criteria (critical Cd concentrations) is based on the consideration of the relationship between the chemical parameters of the element characterizing the soil and the response of plants to these parameters.

Studies were conducted in 2017-2018 on the lands of the former farm RGAZU with plants *Solanum tuberosum,* Nevsky variety. The soil of the experimental site is sod-podzolic light-loamy, characterized by low humus content, weakly acidic reaction of the medium, high phosphorus content and high potassium.

The scheme of the experiment presented in the following tables included a background version with ammonium nitrate, double superphosphate and potassium chloride at the rate of 9g N and P_2O_5 and 13.5 g K_2O per 1 m^2. The initial gross Cd content in the soil, determined after boiling in the extract 5 n. HNO_3 and $HClO_4$ (3:1), was respectively 0.40 mg/kg with the proportion of potentially available forms defined in the extract 1 n. HNO_3, 60-70 %. Artificial pollution of Cd was created by introducing Cd $(CH_3COO)_2$ $2H_2O$ into the soil at the rate of 1, 2, 5, 10 mg/kg of soil, respectively, which corresponds to 1 – 10 maximum permissible concentration for these soils. Repeat experiments 4 times. The arrangement of plots was carried out by the method of randomized repetitions.

Plant samples for analysis were taken 3 weeks after germination, during budding, at the end of flowering, 2 weeks after flowering and before harvesting.

The dynamics of dry biomass growth was determined by drying plant samples at a temperature of 105 ° C to a constant weight; the dynamics of sheet surface area growth – by cutting; calculation of sheet photosynthetic potential by the method of A. A. Nichiporovich, etc.; determination of the net productivity of photosynthesis according to the formula proposed by Kidd, West and Briggs [quoted by 10].

3. RESULTS AND DISCUSSION.

A necessary condition for obtaining high yields of plants is the formation of the optimum leaf area Kayumov M. K. (1982) pointed out that in obtaining the yield of potatoes from 15,0 to 30,0 ton\ hectare (t/ha) average area of the leaves can vary from 17 to 34 thousand m^2/ha. the Maximum area it can reach 25-54 m^2/ha; ratio is the ratio between the maximum and the average area of leaves with a yield of 24.0 – 27.5 t/ha is 1.5 to 1.6; photosynthetic potential under such yield is equal to 3025 – 3440 thousand m2/ha x days. These indicators are the basis of crop programming management [10].

One of the main factors regulating the photometric parameters of potato planting is the optimal ratio of different nutrients in the soil. Their imbalance, excessive accumulation of xenobiotic elements can have a negative effect on these parameters.

The results of our studies in table 1 show that 3 weeks after germination, 38-47% of the maximum leaf area was formed in potatoes of the Nevsky variety.

Table 1 - Leaf area and yield of potato when soil is polluted with Cd, the average rate for the 2017 - 2018.

Experience options	Leaf area, thousand m2 per 1 ha					Yield, t/ha
	Sprouting	Budding	Blooming	Period of the greatest tuber - formation	Harvesting	
N+ P+ K (background value)	19,9	32,5	42,4	37,5	26,0	20,9
Background value + Cd 1	18,8	32,5	44,8	40,2	28,6	23,6
Background value + Cd 2	17,9	31,9	43,8	39,0	26,1	22,6
Background value + Cd 5	16,1	30,5	40,8	33,8	25,9	19,9
Background value + Cd 10	15,8	27,9	41,1	31,5	23,7	17,9

The increase in the level of soil contamination with cadmium to 10 mg/kg was accompanied by a decrease in leaf area by 10% compared to unpolluted soil by the beginning of budding. By the flowering period Cd stimulated the formation of the leaf surface. The largest leaf surface in all variants developed by the third decade of July. It reached 44.8 thousand m^2/ha.

By the period of harvesting, regardless of the level of pollution, the leaf area did not differ and amounted to 23.7 – 28.6 thousand m^2/ha. it Should be noted that the rate of increase in the leaf area under the influence of Cd decreased by the beginning of budding by 13 – 20 %. The area of the assimilation surface was within the optimal range for the Nevsky variety and varied over the years of research, reaching a maximum in 2018. Patterns of changes in its values are like changes in the weight of the tops.

Numerous data indicate that the yield of biomass is directly related to the leaf area. However, the large size of the leaf area is still insufficient to ensure that the leaf surface is formed quickly and as long as possible to actively function, this requires a high photosynthetic potential.

Photosynthetic potential (FP), referred to as the "power" of the leaf apparatus, characterizes the possibility of using for photosynthesis of solar radiation crops of agricultural plants during the growing season and is expressed by the integral area of the leaf surface of plants (m^2/ha) in the continuation of the period of active leaf work. It combines two indicators: the area of leaves and the time of their work. FP is a generalizing indicator characterizing the effectiveness of all methods of technology of cultivation of agricultural plants.

Analysis of the results of the studies shown in table 2 shows that in the studies the AF varied from 165-209 thousand m^2/ha x days in the germination phase to 2251 – 2658 by the harvesting period. In this case, the negative effect of cadmium at all levels manifested from the germination phase to flowering. Thus, at the maximum dose of cadmium, the value of AF by the period of budding decreased by 17%.

The effect of TM on the biosynthesis of organic matter and the formation of economically useful features of plants can be due to their influence on the primary assimilation of carbon dioxide, the qualitative direction of photosynthesis, post photosynthetic reactions, transport of plastic substances and their distribution between organs and tissues. As our studies have shown, soil contamination of TM influenced the intensity of accumulation of dry mass of tops and tubers (table. 3).

Potatoes in the first 1.5 months of its development in tubers accumulated 16-21% in the tops of 50-55% of the total dry weight. The rate of growth of dry mass to the flowering phase increased significantly: dry mass of tubers by the end of this period reached 41-60 % of the maximum amount, and the weight of the tops 100%. For 2 months of vegetation potatoes accumulated 71 - 85% of dry weight of the total crop. By the period of the greatest tuber formation, the weight of the tops decreased by 1 17 %, and the tubers increased by 15-35 % (table.3).

Table 2 - Photosynthetic potential of potatoes during fertilization and soil contamination with heavy metals, thousand m2/ha x days (for interphase periods, average for 2017 – 2018)

Experience options	Sprouting (21 days)	Budding (10 days)	Blooming (14 days)	Period of the greatest tuber – formation (22 days)	Harvesting (20 days)	Total
1.N+ P+ K (background value)	209	262	524	918	635	2548
2. Background value + Cd 1	197	256	541	977	687	2658
3. Background value + Cd 2	188	249	530	951	651	2569
4. Background value + Cd 5	169	233	499	857	596	2354
5. Background value + Cd 10	165	218	483	834	551	2251

Under the influence of cadmium to the flowering phase, the rate of dry mass accumulation by tubers decreased by 13-14%. At the same time, even though the dry weight of the tops to the flowering phase reached a maximum, its absolute weight in variants with doses of Cd – 5 and 10 mg/kg of soil decreased by 11-19%. As is known, the share of organic compounds produced during photosynthesis, accounts for about 95% of the total biomass of the plant organism. Therefore, the change in dry weight can fairly objectively reflect the assimilation activity of plants.

This indicator is the basis for the method of determining the "net assimilation" or net productivity of photosynthesis (NPF). Net productivity of photosynthesis is an increase in the dry mass of plants in grams over a certain time (day), referred to a unit of leaf surface (m^2).

Table 3 - Dynamics of dry mass of plants under soil contamination with heavy metals, t/ha average for 2017-2018

Experience options	Sprouting	Budding		Blooming		Period of the greatest tuber – formation		Harvesting	
	Tuber	Tuber	Tops	Tuber	Tops	Tuber	Tops	Tuber	Tops
1.	1,36	1,82	1,03	3,63	3,01	3,01	4,24	2,83	5,01
2.	1,67	2,20	1,13	4,01	2,71	3,97	4,79	3,04	6,29
3.	1,56	2,02	1,06	3,81	2,47	3,77	4,50	2,88	5,89
4.	1,33	1,69	0,85	3,25	2,10	3,16	3,81	2,54	5,01
5.	1,23	1,59	0,74	3,05	1,88	2,99	3,50	2,37	4,60

The definition of "net assimilation" is of interest in the study of photosynthesis in natural conditions. In case of soil pollution TM NPF provides valuable material for finding the most rational ways to improve crop productivity, forecasting and programming of crops, appropriate placement of agricultural plants in conditions of anthropogenic load on the soil.

Table 4 - Net productivity of potato photosynthesis in soil contamination CD, g/m^2 per day.

Experience options	Sprouting	Budding	Blooming	Period of the greatest tuber – formation	Harvesting	Average per vegetation
1.	3,25	5,66	7,22	0,69	0,93	3,55
2.	4,73	6,47	6,27	2,18	0,83	4,10
3.	4,15	6,10	6,04	2,18	0,77	3,84
4.	3,53	5,19	5,63	1,97	0,97	3,46
5.	3,71	5,03	5,38	1,95	0,87	3,39

Indicators of NPF of potatoes were 3 weeks after emergence 3.3 – 4.7; before budding 5.0-6.5; during flowering 5.4 – 7.2; mass formation of tubers 0.7-2.18 and during harvesting 0.8-1.0 g/m^2 per day (table.4). Thus, the value of net productivity of photosynthesis of potato plantings reached the maximum size during budding – flowering. As plants develop, the leaves of the upper tier shade the leaves of the lower tiers, and this leads to an overall decrease in the productivity of photosynthesis.

Cadmium at doses of 1 and 2 mg/kg of soil intensified leaf activity before budding. In the flowering phase, cadmium reduced NPF compared to the background version by 13 -25%). The productivity of 1 thousand units of sheet photosynthetic potential in the background was close to 8 kg of tubers (table.5). Cd soil contamination had little impact on the productive work of the leaves.

Table 5 - Photometric parameters of potato plantings, average for 2 years

Experience options	Yield biol., c/ha (center per hectare)	Leaf area average, thousand m^2/ha	Leaf area max.., thousand m^2/ha	Photosynthetic potential, million m^2/ha per day	Net productivity photosynthesis (NPF), g/m^2 per day	Productivity of leaves (PRL), kg of tubers per 1 thousand units
1.	7,84	31,7	42,4	2,55	3,55	8,2
2.	9,33	33,0	44,8	2,66	4,10	8,87
3.	8,77	31,7	43,8	2,57	3,84	8,79
4.	7,55	29,4	40,8	2,35	3,46	8,47
5.	6,97	28,0	41,1	2,25	3,39	7,96

The literature data describing the growth rates due to the resistance of crops to HM are ambiguous. One view is that the development of resistance to metals requires additional energy costs, and sustainable plants have lower (20-3O%) productivity than unsustainable plants. At the same time, there are studies proving an increase in growth processes in stable forms compared to unstable ones.

Most of the literature data indicate a decrease in the productivity of agricultural plants under the influence of high concentrations of HM. However, there are studies showing that the phytotoxicity of HM is largely determined by the biological belonging of plants to certain groups. The observed positive phenomena in the study of the authors are explained, most likely, not by the biological necessity of heavy metals, but by the stimulating intoxication of the body under the action of micro doses of toxic substances. In any case, it is necessary to select plants that are most resistant to high concentrations of cadmium in the soil and take measures to reduce its mobility [1,5,18].

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Ensuring Food Security of Russia in the Conditions of Sanitation: Economic and Environmental Aspects

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Abstract

The article is an analysis of the problems of ensuring of food security of Russia in terms of sanctions: economic and environmental aspects are considered. The authors conducted a theoretical analysis of the problem, revealed the factors underlying it, considered the key areas for ensuring Russia's food security soon, and suggested the measures for their implementation.

Keywords: Food security, economic security, environmental security, sanctions, agro-industrial complex (AIC), government regulation.

1 THEORY

The experience of developing of a national model of food security in Russia is of great interest because of Russia's special position on the geopolitical map of the world. In recent years, many steps have been taken in our country to ensure independence, including the area of food supply. At the same time, the problems of finding effective forms and mechanisms of state regulation and support of the agro-industrial complex (AIC) of Russia today are particularly relevant in view of the sanctions against Russia and the subsequent food embargo in response. Today, the state faces new challenges of building up and strengthening of the national food base in order to provide the country's population with food in the required quantity, high quality and environmental cleanliness. The problem of ensuring the food security in Russia in modern conditions is particularly relevant since in the world food has been used as a method of waging modern wars, an instrument of economic pressure and political deterrence.

In Russian academic literature, AA. Anfinogentova, E.N. Borisenko, D.F. Vermel, Yu.S. Khromov, I.G. Ushachev worked at the problem, the impact of the introduction of the food embargo on food self-sufficiency in Russia was investigated by Solodukha P.V., Maiorova E.A., Shinkareva O.V. The authors state that after the introduction of the food embargo in 2014, the self-sufficiency rate increases, but has not yet reached the target value [17]. Chaplyuk V.Z., Andryushchenko G.I., Sorokina L.N., Kukharenko O.G., Petrovskaya M.V. were engaged in the study of the impact of economic sanctions on the Russian economy. The authors note that enhancing the economic growth and solving the problems of import substitution is crucial for the transition from the export of raw materials to the intensive development [12].

The Doctrine of Food Security of Russian Federation formulated the concept of food security. The document clearly spelled out the goal of Russia's food policy - "the guarantee of satisfying the population's need for food mainly at the expense of domestic food products at a level sufficient for its normal life activity" [2]. In the draft of the New Food Security Doctrine, it is planned to expand the range of products and indicators that characterize food security, as well as bring the doctrine into line with the strategic planning documents. The approach to the assessment of food independence is changing. Instead of the share of domestic production in the total volume of resources it is proposed to calculate the self-sufficiency indicator [6].According to the official position of the FAO [8], food security is interpreted as a state "when all people always have physical, social and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences to lead an active and healthy life" [8]. Food security levels are highlighted: local, country, regional, international and global. In Russian academic literature there are several approaches to this issue, but the positions of the most researchers are to some extent like the above.

The Economist Intelligence Unit conducts the annual monitoring of the food safety index for the countries around the world [10]. Thus, according to the classification proposed by the agency, the index of countries with a favourable food situation ranges from 90 to 70, while the best indicators

traditionally fall on the United States, Japan, the United Arab Emirates, South Korea and the EU countries. Russian Federation with the score of 63.8 pp has shown in recent years a significant strengthening of national food security, but still not as high as their level [14].

2 DATA AND METHODS

Analytical materials, statistical data of the Federal State Statistics Service of the Russian Federation were used as research methods for writing the article.

In order to determine the place and significance of food security in the general security structure, we shall use, as a heuristic tool of research, the scheme of security rings by C. Daaze. K. Daaze places environmental security between economic and human security. In our opinion, the latter, of course, is an important and necessary condition for food security. The degradation of the environment, and wider - climate change issues - are linearly dependent on providing the planet with food [13].

The country's food security level is closely interrelated with the state of the environment, soil fertility and production technologies. At the same time, now in Russia there is a deterioration of land conditions, a decrease in fertility, a decrease in the content of humus and nutrients in the soil. Increase in land areas with signs of degradation has reached a critical level [9]. The main negative processes leading to land degradation are both water and wind erosion, and soil erosion as a result of human exposure when using heavy equipment and the irrational organization of irrigation; desertification of the surface, as a result of an abrupt change in the water regime, leading to desiccation and great loss of moisture; waterlogging, land flooding, waterlogging, salinization and alkalinisation of the soil; toxification, i.e., soil contamination with pesticides, herbicides and other agrochemicals that adversely affect the soil, water bodies and groundwater; direct losses of productive agricultural land due to their withdrawal from circulation [16].

Environmental safety is defined as the state of protection of the natural environment and vital human interests from the possible negative impact of economic and other activities, natural and man-made emergencies, and their consequences [1]. In the Strategy for Environmental Safety, the main challenges and threats to environmental safety include increased degradation of land and soil, as well as a high degree of pollution and poor water quality of a significant part of water bodies [4].

“Strategy of the environmental safety of the Russian Federation for the period until 2025” designates the prevention of land and soil degradation as one of the main directions of the implementation of the state policy in the field of environmental safety. These processes are the subject to more than half of the total agricultural land of the country. The total area of polluted land in circulation is about 75 million hectares. The area of disturbed lands that have lost their economic value or have a negative impact on the environment is more than 1 million hectares. Desertification of lands is to some extent observed in 27 constituent entities of the Russian Federation on an area of more than 100 million hectares [4].

An important parameter in achieving food security is the economic affordability of food, i.e. the ability of all citizens of the state, regardless of income level, to acquire the necessary amount of food. The economic availability of food is the level of income and the scale of poverty of the population. Thus, the level of food consumption depends on the ratio of the growth rate of food prices and the growth rate of money incomes of the population [15]. So, if in 2011 the average food expenses in the country were 29.5%, and in 2013 - 27.7%, then by 2018 the situation had deteriorated sharply. Now the national average is 34%, reaching 44.9% in some households. Growth in food prices continues to outpace income growth [16].

Analysing the threats to the economic security of the Russian Federation, many authors note that the main threat to the national economy is the lack of total restructuring of the economic, political, social and spiritual structures of society. What manifests itself in the insufficient development of the newest branches of production, the failure to realize many priority national projects [14]. Until now, the country's economy depends on the export of oil and gas raw materials, food imports, tax increases. It harms the economic security of Russia. The main strategic directions to improve the situation are seen by many authors in the re-industrialization based on innovation and import substitution, the development of science and innovation. Thus, the subject of economic security is the provision of a high standard of living for the population on the one hand and the maintenance of the sovereignty of the state on the other.

3 RESULTS

Having reviewed the main points related to the implementation of the state policy in the field of food security in the context of sanctions, we identified five key areas for ensuring food security of Russia soon and proposed measures for their implementation:

1 - economic: monitoring of food security based on the rating of food security of all constituent entities of the Russian Federation (federal, regional and municipal); support productive farmers; reduction of tax and bureaucratic burden from entrepreneurs engaged in the production and sale of agricultural products; the development of various forms of consumer cooperation and the creation of conditions for the involvement of rural residents; creation of a developed financial and credit and banking infrastructure, private pension funds in the sphere of the agro-industrial complex; income support for agricultural producers at a level that allows for expanded reproduction and implementation of state rural development programs, etc.

2 - production: recreation of domestic seed and breeding bases; improvement of agricultural production technologies ("clean technologies"), intensification of agricultural production, that is, increase in livestock productivity, increase in crop yields. Rejection of manufacturing products based on GMOs.

Agricultural sectors need to be more productive by introducing efficient business models and building public-private partnerships.

3 - trade: integration into the world food system; ensuring a high level of protection of the national food and agricultural market; formation of a developed competitive environment; the creation of production value chains, including production, procurement, processing, sale; creation of conditions for deepening the specialization of regions that contribute to improving the performance of basic foodstuffs; government regulation of pricing for basic foodstuffs; maintaining state food reserves; improvement of all links of logistics, etc.

4 - environmental: improving the state of the environment (solving problems of greenhouse gas emissions, water use and waste); improving soil fertility and ensuring the sustainability of reproduction of soil fertility.

5 - social: implementation of special programs for the development of disadvantaged rural regions (improving access to educational, medical services, housing); legal support to farmers; ensuring the necessary standards for the consumption of basic foodstuffs for all groups of the population, regardless of their status; ensuring the proper diet of the population, necessary for an active and healthy lifestyle.

4 CONCLUSIONS

At the moment there are a large number of difficulties in the way of ensuring food independence of Russia, including: the lack of growth in the volume of state support for the agro-industrial complex; difficult domestic economic conditions; the impact of globalization on the food supply system; income stratification; deterioration in the quality of domestic food; export of certain categories of food with insufficient consumption within the country, etc. In the absence of environmental safety, all components of the concept of food security cannot be fully realized. The practical application of the above measures will improve the domestic agro-industrial complex, will give a new impetus to the development and implementation of rural development programs, will provide an expanded model of food production.

Thus, ensuring food security implies economic and environmental security. At the same time, economic, environmental, and food security are the most important components of state security, which is reflected in the National Security Strategy of the Russian Federation.

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Ecological Insurance as a Financial Instrument for Environmental Protection

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Abstract

The article deals with the formation of an environmental insurance system in the Russian Federation. The main aspects of its development as a financial instrument for environmental protection based on international experience are analyzed. The problems and ways to solve them are identified, concrete actions to improve the legislative framework in the field of environmental insurance are proposed. The system of environmental insurance is analyzed in terms of the economic assessment of damage to the environment caused by industrial and economic objects. Ecological insurance is considered as one of the ways to manage environmental risks. Recommendations are presented on the formation of special insurance reserve financial funds, the funds of which should be used to compensate for damage under insurance contracts. The obtained results serve the main purpose of the study - to identify problem areas in the system of environmental insurance and to develop concrete actions aimed at improving legislation in this area and modernizing the procedure.

Keywords: insurance funds, environmental risk, environmental insurance, damage, environmental management.

1 INTRODUCTION

Today, the most acute problem of environmental insurance, because it can be a deterrent to the destruction of the natural environment [1]. In the developed world, environmental insurance is given great importance, legislation in this area is constantly being improved, conditions for compensation for damage caused to environmental damage are tightened, and the level of responsibility increases. Ecological insurance is a means of protecting the natural environment from the destructive livelihoods of humans. The emergence of environmental insurance as a concept refers to the mid-20th century [2]. Currently, only begins to emerge the legislative framework of European countries in this field. At that time, lawmakers attributed only the safety of industrial accidents to the system of environmental insurance. Following the results of the international conference of 1972, in which representatives of 113 countries, specialized UN agencies, IAEA and other intergovernmental and non-governmental organizations took part, a Declaration on the human environment was adopted. It became the legal basis for the development of Russian legislation in the field of environmental insurance.

2 METHODOLOGY

The basis of the methodological base of the study was ecological, legal and economic publications related to environmental insurance. In conducting the study, an analytical method was applied, which consisted in the in-depth study of the world's theoretical and practical experience in this field [3]. The widespread use of advances in related sciences - jurisprudence and economics, led to the use of a synergistic method. The information and legal base were made up of the Constitution of the Russian Federation, Federal laws and regulatory acts that regulate issues in the field of environmental insurance. When studying the methodological foundations of environmental insurance, historical background has been identified that led to the emergence of a system of eco-insurance. The social retrospective method made it possible to demonstrate the reasons for the formation, development and modernization of the environmental insurance system in the world and in Russia. The object of the study is environmental liability insurance for damage caused to the natural environment. The subject of the study is the system of environmental insurance, which is used to assess the damage caused to the environment by enterprises engaged in economic activity. The information-empirical basis of the study was compiled by documents of the Ministry of Natural Resources and Ecology of the Russian Federation, which are freely available. In the course of the study, a task was set to analyze the current system of environmental insurance in Russia and study the experience of foreign countries: consider

the main practical issues of environmental insurance; identify the main aspects of development and identify ways to improve [4].

3 RESULTS

In Russia, the concept of environmental insurance was first formulated in 1991 in the Law of the Russian Federation "On Environmental Protection", which determined that “in the Russian Federation voluntary and obligatory state environmental insurance of enterprises, institutions, organizations, as well as citizens, objects their property and income in case of environmental and natural disasters, accidents and catastrophes.” Based on this law, the Order of voluntary environmental insurance in the Russian Federation was adopted and approved. And in 1997, the Law of the Russian Federation No. 116 "On the Industrial Safety of Hazardous Production Facilities" was adopted, in which lawmakers prescribed a mechanism for compulsory environmental liability insurance of enterprises that are a source of increased danger. So thirteen years after January 1, 2012, Federal Law No. 225-FZ "On Compulsory Insurance of Civil Liability of a Dangerous Facility Owner for Harm as a Result of an Accident at a Dangerous Facility" entered into force, which was supposed to be more effective in relation to hazardous production facilities. This law did not repeal the effect of federal law No. 116-FZ, but should have supplemented it. However, the federal law No. 2225-FZ did not apply to situations arising from damage to the environment, and this was its main difference from Law No. 116-ФЗ "On Industrial Safety of Hazardous Production Facilities" [5]. The differences between these two laws can be seen from Table 1, which reflects the main differences between the two federal laws.

Table 1 - Differences № 116-FL and № 225-FL

	Comparison	**№ 116-FL**	**№ 225-FL**
1	The presence of the policy	Required when obtaining a license (commissioning of the facility). Weak control and minimum penalty for the absence of a policy.	Required when obtaining a license (commissioning of the facility). Tight control and a penalty for the absence of a policy from 300,000 to 500,000 rubles.
2	The average cost of the policy	6 000 rubles	60 000 rubles
3	Sum Insured Harm Compensation	100 000 - 7 000 000 rubles	10 000 000 - 6 500 000 000 rubles
4	Harm to the environment	Spreads	Does not apply

The main thing that has changed when making the new No. 222-FL is that the liability limit has increased, as can be seen from table 1 almost ten times. Now there is certainly enough money to cover the damage caused to the environment, but the legislator again bypassed the problems of nature and did not include in the law the responsibility for causing harm to the environment. For this purpose, the Federal Law "On Compulsory Ecological Insurance" is being developed, but it has not yet been adopted. The mechanism of voluntary environmental insurance today is governed by the Model Provision "On the procedure for voluntary environmental insurance in the Russian Federation". Currently in Russia, voluntary types of insurance are developing slowly, this is due not only to the lack of an enough legal base, but also the lack of free cash from enterprises for voluntary insurance of environmental risks [6]. Currently, there is no special law that would regulate only environmental insurance, so today we apply the rules of the Civil Code of the Russian Federation to environmental insurance. In addition to the Constitution and the Civil Code, there are several regulatory acts that also regulate relations in the field of environmental insurance, only in more detail. There are also special laws that relate to a specific field of human activity, such laws also introduce their own characteristics of environmental insurance in the area they are considering. Table 2 presents the main legislative acts that regulate activities in the field of environmental insurance in the Russian Federation.

Our country has ratified some international conventions in the field of environmental insurance that are mandatory for application, such as the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, adopted in Rome on October 7, 1952, the Vienna Convention on Civil Liability for Nuclear damage of May 21, 1963, the International Convention on Civil Liability for Oil Pollution Damage, adopted in Brussels on November 29, 1969, and several others.

Table 2 - List of regulations

	№/№	Name of the regulatory legal act	Date of adoption
1	№7-FL	"On Environmental Protection"	10.01.2002
2	№225-FL	"On compulsory insurance of civil liability of the owner of a hazardous facility for causing harm as a result of an accident at a hazardous facility"	01.01.2012
3	№219-FL	"On Amendments to the Federal Law "On Environmental Protection" and certain legislative acts of the Russian Federation	21.07.2014
4	№104-FL	"On the organization of insurance business in the Russian Federation"	21.07.2005
5		"Model regulations on the procedure for voluntary environmental insurance in the Russian Federation"	03.12.1992 and 20.11.1992
	№116-FL	"On industrial safety of hazardous production facilities"	21.07.1997
6	№117-FL	" About the safety of hydraulic structures "	21.07.1997
7	№33-FL	" On the use of atomic energy "	28.03.2002
8	№147-FL	" About space activities "	29.11.1996

On April 21, 2004, the European Parliament and Council Directive 2004/35 / EC "On environmental liability in relation to the prevention and elimination of environmental damage" was adopted. Since in developed countries, environmental insurance began to develop much earlier than in our country and more attention is paid to it every year, a mechanism for assessing environmental damage has been developed in detail [7]. In European countries, there is a developed and legislatively established methodological base, based on which the damage is assessed, and financial obligations are made to eliminate this damage. If the company has not insured its risks, then it may not even expect to cooperate with it. Insurance companies constantly increase tariffs, the cost of an insurance contract is constantly becoming more expensive, and it is beneficial for the insured to increase the level of security of his enterprise than to pay for the damage in the future. According to accepted international practice, damage or harm caused to life and health, property, the natural environment, as well as lost profits or economic losses are compensated. A separate item reimburses expenses aimed at preventing damage [8]. Damage to property or life and health is determined by the court in a lawsuit. It is also necessary to consider the question of how the population is protected from unforeseen and emergency situations, including environmental risk in foreign countries. All over the world, the function of protecting the population from environmental disasters, except for Russia, belongs to insurance companies. For the best performance of the protection function, insurance companies required an increase in the budget, therefore, since 1979, special funds began to be created abroad, which allowed to increase the maximum insurance amounts for damages. Such insurance funds are called pools. Such pools exist in Japan, France, the Netherlands, Sweden and the UK. In parallel with the insurance for environmental pollution and insurance pools, there is also mutual insurance by enterprises of each other. That is, the two companies agree that they will insure each other against an unforeseen emergency event and create their own reserve fund, while the enterprises have the right to refuse the services of the insurance company. In this case, if at one of the enterprises accidental pollution occurs, then funds for compensation for damage and elimination of consequences are taken from this mutual fund.

In the Russian Federation, the Institute for Environmental Insurance is a new institution, the history of which has only about 25 years. The legislation lacks a clearly defined concept of environmental insurance. In the process of studying the issue of environmental insurance can be defined to protect the environment from hazardous human activities, as a tool that determines the size and procedure for payment of compensation for harm to the environment. The goal of environmental insurance is to indemnify legal entities and individuals for damages resulting from harm. In our country, environmental insurance is a function of the state, despite the fact that insurance itself, that is, the conclusion of an insurance contract lies with insurance companies, usually partly with state capital, the responsibility for eliminating the consequences of harm caused lies entirely with the state, namely at the Ministry of Emergency Situations of the Russian Federation [9].

Under Russian law, enterprises whose activities are dangerous in themselves, as well as enterprises that have dangerous objects, must insure the risks of harm. Also, their risks of pollution should ensure objects that themselves are not dangerous, but due to a natural disaster, such as fire, explosion, flood, earthquake, landslides, and so on, can cause serious harm to the environment. Also, the possibility of

environmental insurance is also provided for individuals if the objects of their property and income can harm the environment [10]. The subjects of environmental insurance are the insurer and the insured. The insurer is, as a rule, the insurance company with which the insurance contract is concluded. In the case of compulsory environmental insurance, the state acts as an insurer. An enterprise that falls under the dangerous principle of Act No. 116 – FZ "On Industrial Safety of Hazardous Production Facilities" dated July 21, 1997, is obliged to make compulsory insurance contributions in the form of contributions to the state budget [11]. Insurers can be both physical and legal persons, the main condition for entering an insurance contract is the ownership of a source of increased danger that can harm the environment. Environmental insurance is divided into voluntary and compulsory [12]. The rules of voluntary insurance are stipulated by the "Standard Regulation on the Procedure for Voluntary Environmental Insurance in the Russian Federation". The main difference between voluntary insurance and compulsory insurance is that the state does not enforce, does not define any criteria for insurance, that is, the insured himself applies to the insurance company with a desire to insure the risk of environmental harm to third parties. And already the insurance company, based on the Model Regulations, develops its rules on voluntary insurance specifically for each policyholder, namely the list of pollutants, as well as the causes of insurance events and damages that are recoverable. The insurance rules specified in the " “Model Provision on Voluntary Environmental Insurance in the Russian Federation" allow insurance companies to independently determine: types of environmental insurance; list of objects to be insured; insurance coverage; level of insurance coverage; policyholders Rights and obligations of parties involved in insurance; tariff rates of insurance payments [13]. Another difference from voluntary insurance from compulsory insurance is that only legal entities can be insured. They can be of both Russian and foreign origin. The main condition is that the insurance object must be in Russia. The presence of a policy of voluntary environmental insurance of environmental damage significantly enhances the status and prestige of any enterprise. This indicates that the owners of the company take care of the protection of the environment not only in words but in deeds and have free money for this. Mandatory environmental insurance applies only to businesses that pose a heightened environmental risk. Federal Law No. 116-ФЗ "On Industrial Safety of Hazardous Production Facilities" determines the list of hazardous facilities to which compulsory environmental insurance is mandatory applied [14]. The types of environmental insurance include: liability insurance for owners of sources of increased environmental risk in the event of pollution of the environment, harm to life and health of individuals; insurance of natural objects and complexes in case of occurrence of environmental emergencies caused by natural disasters; life and health insurance of individuals in the event of environmental emergencies caused by natural disasters and man-made accidents; insurance of contractual liability of users of natural resources, namely: water users, subsoil users, land users, users of forests; insurance of financial risks in terms of insuring the costs of restoring natural objects or the natural environment (for example, the costs of reforestation, firefighting costs, the cost of cleaning reservoirs from oil spills, etc.) [15].

The most difficult type of compulsory insurance is the contractual liability of nature users. In this case, it is initially quite difficult to assess the risks. Risks are assessed for each specific object separately for certain parameters, namely: for the materials used at the enterprise, for its location, for the production process, and for the safety standards adopted at that time. When assessing risk, special attention is paid to the possibility of water, air and soil pollution. Voluntary use is extremely rare. For an explanation of why enterprises are not in a hurry to conclude voluntary environmental insurance contracts, there are several valid economic reasons. One of the reasons is that enterprises are simply not interested in voluntary liability insurance, the reason is simple and simple - funds for drawing up a voluntary insurance contract should be separated from the company's profits, which is extremely difficult for the enterprise and sometimes unprofitable, especially in a crisis situation. when not enough money to pay wages. Another reason is that the state does not provide any programs that encourage voluntary insurance, for example, tax breaks for conscious enterprises that are willing to voluntarily insure themselves. The solution to the problem of unwillingness to insure could be the introduction of compulsory insurance for all economic entities, according to the principle of CTP, however, so far this is also problematic. The first of these reasons is the same - the allocation of funds from profits is a great luxury for many enterprises today in a crisis [16]. The second reason is that the money spent on registration of insurance will have to somehow justify, respectively, increases the cost of the company's products, and as a result, payment of such insurance will fall on the shoulders of the consumer who will purchase the final product. The third reason, and today the most important one is the absence of a special law on compulsory insurance of harm to the environment. According to the experience of foreign countries, the culprit of causing environmental damage, in addition to applying the principle “Polluter pays”, is also obligated to eliminate pollution on its own [17]. State services are connected only if the pollution is of a large scale and the culprit is simply unable to cope on his own,

without forgetting that the culprit pays for all activities related to the elimination of dangerous consequences. In our country, no matter who is to blame, whatever the scale of harm to the environment, all the responsibility for eliminating pollution lies with the Russian Emergencies Ministry - the state structure, respectively, and state funding. With a voluntary insurance contract, the situation practically does not change. In this case, the damage caused to nature is partially reimbursed by the insurance company within the maximum insurance amount specified in the contract. But often these funds are not enough to fully cover the damage, and the consequences of the damage caused are eliminated by the state structure [18]. An analysis of the situation in the field of environmental insurance allows us to conclude that the facts that inhibit the development of the environmental insurance system in Russia are: the lack of a sufficient legislative base, namely the absence of a special law or laws that would regulate the relations of subjects with compulsory and voluntary environmental insurance ; the absence of mechanisms for assessing the damage caused to the environment, human life and health at the stage of concluding insurance contracts; lack of statistical data on damage to the environment, human life and health; lack of insurance pools; the absence of insurance companies that could take responsibility for compulsory and voluntary environmental insurance; lack of qualified and sufficient personnel in environmental insurance; depreciation of equipment of most enterprises belonging to hazardous production facilities; unwillingness of enterprises to insure liability for environmental damage through voluntary environmental insurance; lack of economic incentives for enterprises that have entered into voluntary insurance contracts.

4 DISCUSSION

On November 15, 2003, by its Resolution No. 22–19, the Inter-Parliamentary Assembly of the CIS Member States adopted the Model Law "On Environmental Insurance". The law spelled out the concept of environmental insurance, that it is mandatory and voluntary, the rights and obligations of the parties, and most importantly, the law is aimed at protecting the environment, that is, it is supposed to pay damages for damage caused to natural objects. CIS member countries have committed themselves to bring their domestic legislation in the field of environmental insurance in accordance with this Model Law in the next 5 years from the date of adoption of this law. For example, in Kazakhstan, a similar law has been successfully operating for several years, while in Russia, a similar law has not yet been adopted, and the current legislation is far from perfect. Many experts agree that this law quite fully and clearly reflects everything necessary for regulating environmental insurance and could well become a prototype of a similar law in Russia.

For a clear operation of environmental insurance, Model Law proposes the creation of:

The mutual insurance society, which must include at least 30 legal entities, with its charter and insurance supervision body, as well as joint subsidiary liability for all insurance contracts;

National Association of Insurers in the form of a self-regulating enterprise. The responsibility of the organization will be the development and implementation of common methods and approaches to environmental insurance. The national association will have to ensure the financial sustainability of all activities in environmental insurance.

The Model Law also provides solutions to the issues of financing environmental insurance. To ensure the financial sustainability of environmental insurance, it is proposed to create a multi-level guarantee system, which should include special requirements for insurers and control over their activities. One of the requirements is the obligation of insurers to form special insurance reserve financial funds, the funds of which should be used to compensate for damage under insurance contracts, as well as to preventive measures. The law also provides for the possibility of reinsurance of an environmental insurance contract, including in foreign insurance companies. Contingency funds will have to be made up of contributions from policyholders, and the state will exercise control over the expenditure of these funds through a special state authority that deals with environmental issues. The procedure for spending the reserve fund will be carried out by the governing body of the national association of insurers by adopting a budget for the relevant period [19].

The state, in turn, acts as a guarantor of compensation to third parties for losses to the natural environment, which occurred as a result of a dangerous incident at an uninsured or unidentified object. For these purposes, a state guarantee fund for environmental insurance should be created, which will be formed from insurance contributions under compulsory environmental insurance agreements, in this case, the state will determine the tariff rates, and the companies that have their insurance funds will pay the national association of insurers, as well as through donations of individuals and legal

entities. The activities of the state environmental insurance fund are supposed to be directed both to the development of voluntary environmental insurance and to preventive measures. The guarantee state fund will receive the right to demand from the owners of enterprises compensation of expenses for damages caused to the environment in the absence of any type of insurance contract from this enterprise. The law also imposes an obligation on the state to take a list of measures to stimulate insurance, for example, the introduction of certain benefits in the taxation of enterprises that have entered into contracts of liability insurance for causing damage.

After studying the Model Law, a natural question arises: "Why hasn't our legislative assembly passed such a law so far? After all, more than 10 years have passed since the adoption of the Model Law by the CIS countries?" One of the reasons for such a delay in the adoption of a special law is the inability of one individual insurance company to draw the risk of liability under insurance contracts. Therefore, in our country it is necessary to create insurance pools, that is, associations of insurers with a total capital following the example of foreign countries. This made it possible to increase financial capital and finally it would be possible to pass a law "About environmental insurance". It has been established that the main problem of environmental insurance today is the absence of a special federal law that would regulate relations in the field of environmental insurance. It was revealed that this law could become a universal instrument in the sphere of regulation of relations between the subjects of environmental insurance, both with compulsory and voluntary environmental insurance, would eliminate the gaps in the current legal framework in environmental insurance and help direct environmental insurance to environmental protection. It is proved that the law on environmental insurance should reflect the main principle of environmental insurance "the polluter pays", it will remove the obligation to eliminate environmental damage to the state, and oblige the owner of the enterprise that caused environmental damage to pay for the damage [20].

Another problem of the effectiveness of the environmental insurance system was the lack of an insurance reserve fund in our country. This insurance fund would help solve the problem of financing environmental risk insurance, since such a fund can accumulate funds from insurers, which can then be directed not only at eliminating the consequences of an environmental disaster, but also at preventive measures aimed at preserving the natural environment. It was revealed that it is necessary to adopt a special law on compulsory environmental insurance, which would help consolidate the obligation of enterprises engaged in hazardous activities that may cause accidents and, as a consequence, cause harm to the natural environment, and necessarily enter into environmental insurance agreements on the principle of OSAGO.

5 CONCLUSIONS

To eliminate the existing gaps in the system of environmental insurance in Russia, it is recommended:

to bring the legislation in line with the Model Law adopted by the Inter-Parliamentary Assembly of the States Parties to the Commonwealth of Independent States, and to adopt the law “On Environmental Insurance”;

adopt the Federal Law “On Compulsory Insurance of Liability for Harm Caused by the Environment Caused by a Business Entity and Other Activities”, which is developed by a working group under the Federation Council Committee on Science, Culture, Education, Healthcare and the Environment;

to create in our country an insurance reserve fund, according to the experience of foreign countries, this will be able to attract quite a lot of capital in the sphere of environmental insurance, which will remove some of the financial burden from the federal and regional budgets;

create a system of incentives for voluntary insurance for enterprises, for example, to introduce substantial tax breaks for enterprises that have entered into voluntary environmental insurance contracts, and for enterprises that invest in the modernization of cleaning equipment, and for enterprises that regularly carry out hazardous consequences prevention measures;

create independent centers throughout the country to collect hazardous accident statistics that cause damage to the natural environment.

Regular data collection will help form the mechanisms for assessing the damage caused at the stage of signing environmental insurance contracts. After the adoption of relevant laws and the introduction of incentive methods for environmental insurance, toughening of the system of state environmental control and prosecution of environmental offenses is possible. With the mandatory implementation of

all the recommendations, our environmental insurance system promises to be a serious tool in the struggle to preserve the environment for future generations.

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On the Approach to Substantiating Decisions on The Elimination of the Effects of Domestic Gas Explosions

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Abstract

The article proposes a method of calculating the attracted forces and assets, structural units that are part of a unified state system of prevention and liquidation of emergency situations, to eliminate the consequences of emergency situations associated with the explosions of household gas at residential facilities. The technique was implemented in the form of an interactive system for predicting the state of residential facilities in conditions of domestic gas explosions and developing proposals for the formation of a rational composition of the grouping of forces and means to eliminate the consequences of explosions.

Keywords: explosions, forces and means, household gas, information and control systems.

1. INTRODUCTION

Currently, the accident statistics on domestic gas explosions in Russia is disappointing [1], as evidenced by both data from previous years and the latest events of November-December 2017.

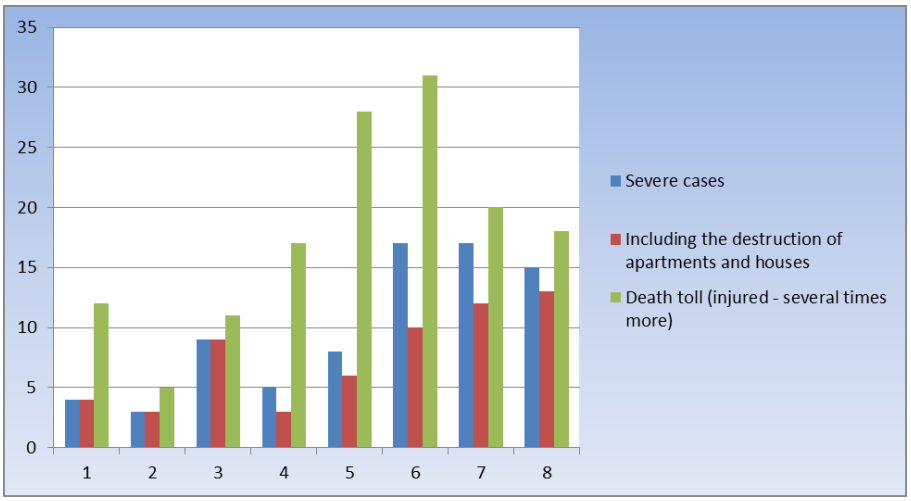

Fig. 1. Statistical data on domestic gas explosions in residential buildings

The explosions of domestic gas lead to large amounts of casualties, material losses. The Ministry of Civil Defence, Emergencies and Disaster Relief faces the task of preventing such explosions and eliminating their consequences (minimizing the loss of human life and economic losses). The fulfilment of these tasks is possible only if all factors affecting the circumstances of the emergency that led to the explosion are considered and if the rescue tasks and other urgent work are properly organized to eliminate the consequences of the explosion.

Proper organization and conduct of rescue tasks and other urgent work are possible only with the proper organization of the management system of the forces and assets involved in eliminating the

consequences of the explosion. To assist decision-making, automated information management systems (hereafter, AIMS), based on the geo-information systems already developed, have been introduced in order to enhance the ability of management systems to prevent and eliminate emergency situations, to develop optimal solutions at all levels of management, and also increasing the readiness of communication and warning systems, forces and means to act in emergency situations [2]. Unfortunately, many software products created (operating in AIMS), often unrelated to each other, do not simplify the work of the heads of government bodies, but also make it difficult. All this may ultimately lead to the irrational use of attracted forces and means to mitigate the consequences of an emergency [3], or to the disruption of the implementation of the tasks set in a timely manner.

2. METHOD

Therefore, there is a need to develop proposals for the formation of a rational composition of the grouping of forces and means to eliminate the consequences of the explosions. At the same time, for the qualitative solution of the task of forming a group it must work through the following questions:

- to simulate the situation that develops as a result of the explosion of household gas at the residential development object;

- to calculate the required amount of forces and means necessary to eliminate the consequences of a domestic gas explosion;

- to form a rational grouping of forces and means required to eliminate the consequences of the explosion of household gas;

- to develop proposals for laying the optimal route for the input of forces and assets to the work sites.

Modeling of the situation resulting from the explosion of domestic gas at the residential development object is carried out on the basis of the scenario where the type of object, the year of its construction, the number of rooms in the apartment where the explosion occurs, the time of day, the floor on which the apartment is located, the nature of the residential gas in the apartment.

$$\Delta P = \frac{M_g \cdot H_T \cdot P_0 \cdot Z}{V_{CB} \cdot P_B \cdot C_p \cdot T_0} \cdot \frac{1}{K_H} \quad (1)$$

where Mg is the mass of household gas in the mixture;

Z is the participation rate of household gas in combustion (= 0.5);

H_T is the heat of combustion (= 41.51 MJ / kg);

P_0 is the initial pressure (= 101 kPa);

V_{CB} is the volume of rooms where the formation of gas-air mixture;

T_0 is an absolute temperature, initial, (= 293 K);

C_p is the heat capacity of air (= 1010 J / kg · K);

ρ_B is the air density (= 1.225 kg / m3);

K_N is the coefficient of considering the leakage of the room (= 3).

The calculation of the degree of destruction of residential objects is carried out based on the methodology described in [4], based on the calculated values of excess pressure (Table 1).

3. CALCULATION

The calculation of the required amount of forces and means necessary to eliminate a domestic gas explosion is carried out based on the methods described in [5]. The obtained data on the required number of forces and means can be used by the heads of structural subdivisions that manage the Unified state system of emergency prevention and response when making decisions on emergency response. However, this information is often not enough to make an informed decision to attract those

or other structural units relating to the Unified state system of emergency prevention and response forces.

Table 1. Values of excess pressure with the appropriate degrees of destruction of residential objects

№	Degree of damage	Values of overpressure, kPa
1	Complete destruction of buildings	100
2	50% destruction of buildings	53
3	Average damage to buildings	28
4	Moderate damage to buildings (damage to internal partitions, frames, doors, etc.)	12

For the formation of a rational grouping of forces and means required to eliminate the consequences of a domestic gas explosion, it is necessary to consider the possibility of attracting the widest range of forces required. The solution of this task will be to determine the optimal plan for the formation of a grouping of forces of the Unified state system of emergency prevention and response in such a way that the work on the aftermath of the explosion of household gas will be carried out in full and with minimal time, involving as few specialists as possible. At the same time, the mathematical problem of linear programming of a special type (transport problem) is solved for each type of special equipment, gear and each type of specialists (Fig. 2 and 3) (determined by the methodical instructions [5]).

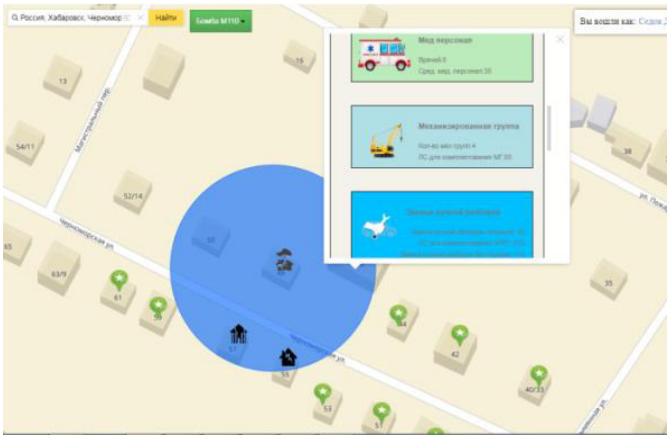

Fig. 2. An example of calculating the required amount of forces and assets in an interactive system

When solving the transportation problem, the time of arrival of the structural units (taking into account the sequence of their entry into the work area) can be taken into account; the effectiveness of the emergency and rescue equipment used, the readiness of the personnel of the units, other factors, etc.

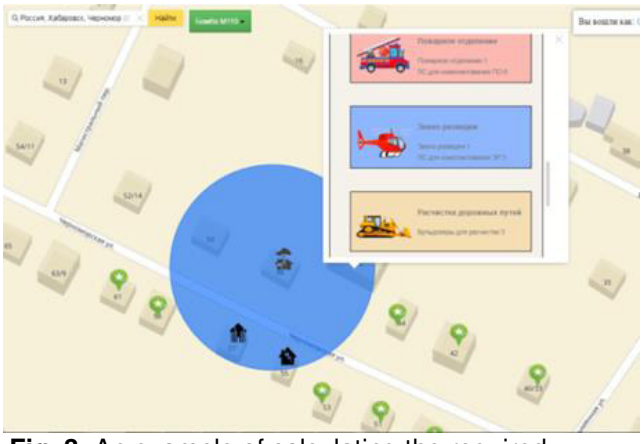

Fig. 3. An example of calculating the required amount of forces and assets in an interactive system

A general view of the matrix required to solve the transportation problem can be represented as follows:

Table 2. The matrix for solving the transport problem for the i-th specialist

	Work area				
	Area 1	**Area 2**	**…**	**Area n**	**Total manpower**
Object 1	t_{11}	t_{12}	…	t_{1n}	x_1
Object 2	t_{21}	t_{22}	…	t_{2n}	x_2
…	…	…	…	…	…
Object m	t_{m1}	t_{m2}	…	t_{mn}	x_m
The need to solve problems	y_1	y_2	…	y_n	$\Sigma y / \Sigma x$

Where

n – the number of sites on which the work is carried out;

m – the number of units from which forces and means are attracted;

y_n – the required amount of forces and means at the work sites;

x_m – the number of forces and means in the units where the attraction to work comes from;

t_{mn} – the time of delivery of forces and equipment from each object to the appropriate area.

The information displayed in the cells of the table will be the time of arrival at the site of work. Filling the cells is carried out considering the separation of forces and equipment and the need to provide for a reserve.

The basis for drawing up the initial plan (Table 2) in the software environment, which is an interactive system for predicting the state of residential buildings in conditions of domestic gas explosions and developing proposals for the formation of a rational composition of the grouping of forces and means for eliminating the consequences of explosions, will be served every day the change of the day-to-day management body - the regional center for civil defense, emergency situations and disaster management and the authority, with information about the forces of the unified state system of warning and emergency response (hereinafter RSChS) for each structural unit that is part of the RSChS forces.

It should be noted that the use of the transportation task for the formation of a rational grouping of forces and means has already been undertaken [6].

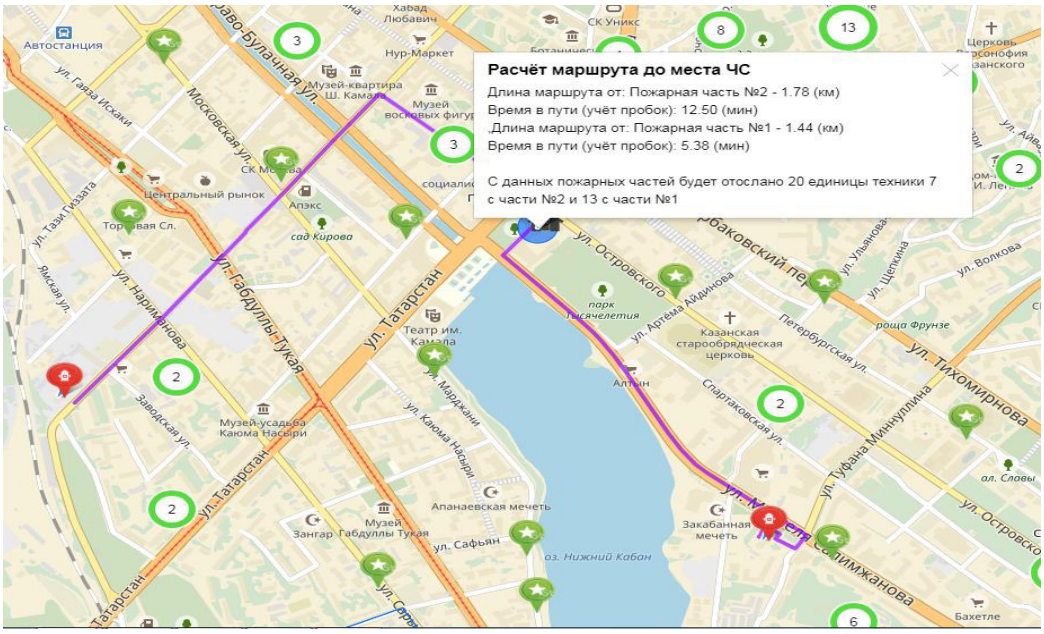

Fig. 4. An example of the working environment of an interactive system with a solved transportation problem

In addition, the platform of the interactive system (based on the geographic information system) allows the mapping of the entry routes of the structural units involved in the formation of the grouping of forces and means depending on the situation on the transport network (Fig. 4).

Thus, having solved the transportation problem for all the necessary specialists for eliminating the consequences of the strike, we will determine the required amount of forces and means from each organization that is part of the subsystem of the emergency response system.

4. CONCLUSION

The paper presents an interactive system based on the proposed approach and designed to ensure the functioning of the AIMS of the RSChS, which allows, based on an assessment of the situation resulting from an emergency, to calculate the required amount of forces and means for carrying out the work to eliminate the consequences of an explosion. One of the directions of formation of a rational composition of the group involved in its liquidation is shown.

The novelty of the proposed interactive system is in the application of algorithms used to solve the transportation problem to form a rational grouping of forces and means designed to eliminate the consequences of an explosion. This will allow the selection of structural units from where it is planned to attract forces and means to eliminate the consequences of the explosion, taking into account the workload of the transportation network, the effectiveness of the rescue equipment used, the readiness of the personnel of the units, etc.

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Featers of The Development and Influence of Landslide Processes on The Road A-149 Adler-Krasnaya Polyana in Krasnodar Region

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Abstract

The article analyzes the formation of landslide processes on the territory of the section of the road A-149 Adler-Krasnaya Polyana, Krasnodar region. The slope stability assessment was carried out, as a result of which it was found that the slope is unstable and additional measures are required to stabilize it.

Keywords: landslide processes, road, landslide slope, anti-landslide structures.

1. INTRODUCTION

The consequences of landslides are very different. They destroy homes and endanger human settlements, destroy agricultural land, make it difficult to till the soil, create danger when working in quarries. Landslides damage communication networks and infrastructure of settlements threaten hydraulic engineering and water facilities. They can form lakes and contribute to the appearance of floods, generate destructive waves in the bays. As a result of landslides riverbeds are blocked and there is a change of landscape. Landslides destroy roads and threaten the safety of road and rail traffic.

Thus, landslide processes lead to significant changes in various components of the environment significantly changing it. This necessitates the improvement of methods of monitoring, forecasting and elimination of landslide processes to maintain favorable conditions for the existence of living organisms (e.g. [1], [2], [3], [13]).

2. THEORY

Natural and climatic conditions, lithological and structural features of rocks composing the slopes, anthropogenic impact contribute to the development of many landslides on road sections in the Krasnodar region.

The territory of Krasnodar region is characterized by intensive development of exogenous geological processes, including more than 16 thousand landslides. This is due to the complex geological structure, tectonic disturbance, a large diversity of lithological composition of indigenous and Quaternary rocks, a significant steepness of the slopes and climatic features of the region.

The formation of landslide processes in this area depends on many factors: the shape of the terrain, physical and mechanical properties of soils, their ability to the processes of swelling-shrinkage, surface and groundwater regime, external load parameters, etc. the Main accompanying engineering-geological processes are: subluxation of the base, weathering, suffusion, reduction of strength during soaking and vibration. The reasons for the activation of landslide displacement may be heavy rains, seismic effects and additional loading (e.g. [10], [12], [13]).

Many roads in the Krasnodar region laid along the riverbeds.

3. DATA AND METHODS

Let us consider the influence of the river on the example of the section of the Federal highway A-149 Adler - Krasnaya Polyana, laid along the Mzymta river. As a result of the erosion of the right Bank, on km 19+500 - km 19+660 there was a destruction of the roadside and barrier fence. The high intensity of the slope processing in this area is due to the bend of the river - the flow approaches at an acute angle to the shore, destroying its base (Fig. 1).

Figure 1 - Destruction of the section of the road A-149 Adler - Krasnaya Polyana, km 19+500

4. METHODS

The task of assessing the stability of the existing landslide (there is already an actual sliding surface) is to determine the degree of stability, the degree of threatened landslide movements for existing structures and the safety of the area, as well as the establishment of the direction of anti-landslide measures to prevent their dangerous action (e.g. [4], [5],[6],[8],[9],[10]) .

When the task is to assess the stability of the slope or slope (the sliding surface has not yet formed), in this case, we mean the forecast of the possibility of landslides, the justification for the steepness of the slopes and the need for other measures to ensure their stability (Fig. 2) .

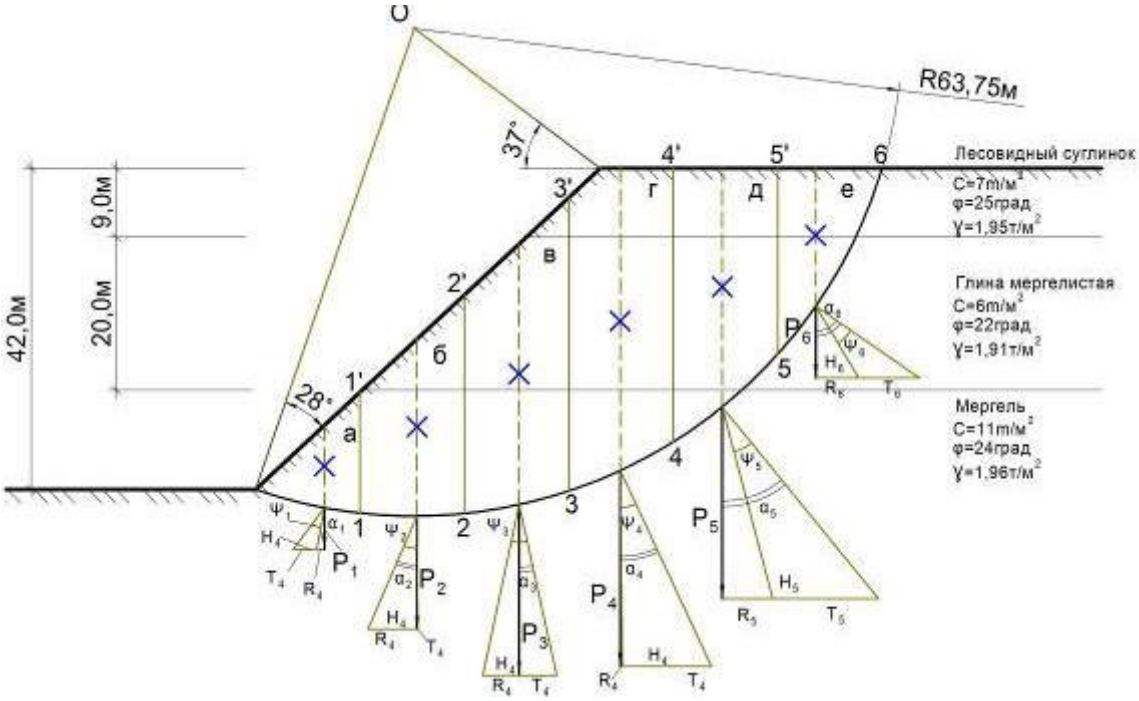

Figure 2 – Calculation scheme of the surface slope

The area bounded by the surface of the slope (slope) and the slip curve is divided into six compartments by vertical lines (e.g. [7], [14]). The zero compartment is placed under the center of the slip curve, the remaining compartments are numbered with ordinal numbers to the right. Next is the equation of moments of forces acting on the compartments relative to the center of the slip curve. The lateral ground pressure forces acting on the vertical faces of the compartment are not considered, since they are internal (e.g. [6],[11], [15]).

For each block is determined by the angle α between the vertical and normal components, drawn from the projection of the center of gravity of the block on the slip curve.

Calculate the weight of the soil in each block, found by the formula:

$$P_i = F_i \times \gamma_i \quad (1)$$

For each block, the angle α between the vertical and normal components, drawn from the projection of the center of gravity of the block on the slip curve, is determined.

The angle of shear resistance for each designated compartment is found by the formula:

$$\psi_p = arctg\left(tg\varphi + \frac{C}{P}\right) \quad (2)$$

The force *H*as a projection on the horizontal axis *N* is a thrust, that is, the pressure on the vertical wall of the lower unit, in the absence of friction and adhesion in the ground.

Force *T* is this part of the thrust perceived *H* by friction and clutch.

The results of the calculations are summarized in table 1.

Table 1 - Calculation Results

№ bloc k's	*P ,m/м*	α,	ψi, °	*H, t/m*	*T, t/m*
1	261,11	36,9	24,03	164,0	123,2
2	702,04	23,8	23,5	259,2	3,6
3	952,79	24,43	24,3	386,4	196,4
4	737,78	24,41	24,4	476,4	466,4
5	383,49	39,9	24,4	814,8	551,6
6	94,47	55,3	24,2	540,4	316,0
Result:				2641,2	1657,2

By calculating the sum of forces *H* and *T* on the blocks of the entire landslide slope, we can determine the corresponding factor of safety.

$$n = \frac{\sum T_i}{H_i} = \frac{1657,2}{2641,2} = 0,627 \quad (3)$$

***n*<1-** consequently, the slope is unstable, stability stabilization measures are required.

The anti-landslide dam with slopes fixed by wire anchors with conical or rotary tips will significantly increase the resistance from the landslide of the slope mounts at minimal cost, to the maximum extent to use the strength properties of the metals from which the anchors are made. All this makes the design as cheap and effective in the fight against landslide processes along the roads.

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The Problem of Managing Municipal Solid Waste in The Context of a Sharing Economy

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Abstract

The article deals with the problems of making and making decisions in the field of municipal solid waste management at the municipal level. The combination of systemic problems of management and financing are of importance as a result of the implementation of the reform of MSW in the Russian Federation. The study reflects the set of operational problems of the municipal organization, economic and mathematical substantiated resource constraints that impede the implementation of operational activities and the algorithm for developing and making management decisions at the level of the municipality.

Keywords: Waste management system, continual improvement, Solid Waste Management, Sustainable waste management

1. INTRODUCTION

Urbanization has a significant impact on the ecological and evolutionary processes of socio – economic development [2] Therefore, sustainable development of economies is impossible without “clean development” [16] Modern trends in the functioning of the urban economy lead to overpopulation and, consequently, to an ever-increasing problem of management of solid municipal waste, in 2016, only 12% of all solid waste was disposed of. According to the World Bank by 2050. solid waste is expected to grow by 70% at 3.6 billion tons of garbage per year, whereas as of 2016, this figure was estimated at 2.01 billion tons. [14]

The progressive growth of solid waste is a pressing environmental issue for both developed and developing countries. At the same time, the share of developing countries accounts for a significant proportion of pollution by solid municipal waste, which reduces the quality of living space, both at the local, national, and global level [15]

A study on the management of municipal solid waste in China showed that it is the growth of population, economic development and increase in the expenditures of residents are the main factors affecting the volume and composition of garbage [1]

The problem of management of municipal solid waste, associated primarily with the lack of an effective mechanism for organization and control, which in turn leads to the formation of illegal places for the accumulation and storage of waste, noted in Slovenia and Croatia. [2] The emergence of a significant number of illegal landfills for storing garbage causes significant problems in socio-economic terms, and in consequence affects the health of the population and the functioning of the ecosystem as a whole.

In Italy, technological solutions and a scenario approach based on the reuse of MSW for energy production are used to solve the problem of management of MSW [8]

Scientists from Jordan [9] also state the problems of growing solid waste exponentially, expressing fears of excessive pollution of natural resources and the environment.

According to [17], information asymmetry and the growing awareness of the local population about the harm of unutilized municipal solid waste contributes to the ecological behaviour of individuals. The study [18] emphasizes that public awareness of the dangers of municipal solid waste itself is not yet a guarantee of the manifestation of the ecological clean behaviour of the population. So Sadhan Kumar

Ghosh [5] identifies the weakness of institutional initiatives and the lack of public awareness as key factors in the inefficiency of municipal solid waste management.

In Indonesia, the search for solutions to the problems of MSW management is conducted in the field of formation of a waste management system based on management programs that are prescriptive - top-down [3]. Muliawaty, L. [3] argues that the formation and implementation of an effective state policy for the management of municipal solid waste is not possible without the participation of the community as the main waste producer. An identical point of view is characteristic of the Indian community.

We also note that the Russian Federation is following this path with the new reform of the management of the MSW from 2019 [7].

In the work [19] it is noted that at the local level, in case of solid pollution, three problems are the most important: first, the increase in solid waste, second, the change in the quality of solid waste; thirdly, the process of transporting the collected waste and its disposal.

Our position is also close to the above, because without the support of the population, without forming a culture of collecting and sorting garbage from the population, there is a significant threat to the ineffectiveness of implementing the state policy of managing the MSW or delaying its implementation, which will lead to the need for additional funding. Thus, the purpose of this study is defined as the study of the Russian practice of municipal solid waste management in the context of the reform of MSW from 01/01/2019.

2. METHODOLOGY

The Russian Federation is in the initial path of reforming the municipal solid waste management system. The main regulations of the MSW reform are enshrined in the Federal Law No. 89 «On Production and Consumption Waste», as amended on January 1, 2019 [7]. The changes made are not currently being implemented in all the constituent entities of the Russian Federation, since some regions and cities of federal significance have been deferred (Moscow, St. Petersburg, Sevastopol). It should be noted that the implementation of this reform is difficult and has many negative consequences, which, on the one hand, is justified by the lack of readiness of local executive authorities to assume this level of responsibility and the lack of effective mechanisms for implementing “garbage reform” at the municipal level. In Figure 1 we present a set of system management problems of effective management of MSW arising at the lower level - at the level of the municipality and organization.

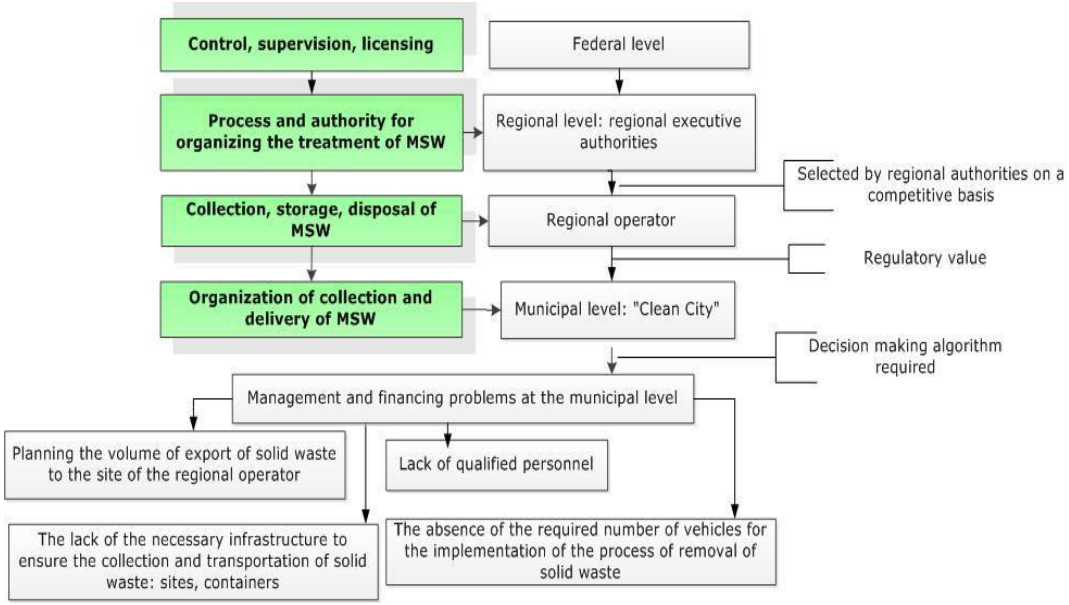

Fig. 1 Systemic problems of management of MSW at the level of a municipality (municipal organization) arising in the process of implementing the reform of MSW 2019 in the RF

Source: Author

From Fig. 1 it can be seen that the direct executor in the field of collection and transportation of MSW - a municipal organization - is not currently able to effectively accomplish the tasks, since on the one hand it does not have sufficient production resources, and on the other hand it needs a significant amount additional funding. The practical implementation of the tasks requires the managers of the municipality to make informed management decisions based on planning and forecasting the export of MSW based on the normative value of MSW volumes per 1 citizen living in a rural or urban area assigned by the regional operator. This task brings to the fore the relevance of the existence of an algorithm for the development and adoption of managerial decisions at the level of the municipality. This algorithm is presented in the following sequence of steps:

Step 1 - collecting the necessary initial information for 5-7 periods (Fig. 2);

Step 2 - using the methods of economic and mathematical modeling, trend models are built, and the most qualitative and reliable model is selected (Fig. 3);

Step 3 - based on the trend model, the forecast values of the resulting feature are calculated (Table 1);

Step 4 - the established standard value of export of MSW per 1 inhabitant is determined based on regional regulations;

Step 5 - calculation of the forecast value of the organization's revenue considering the standard tariff of the regional operator and the forecast volume of export of MSW is made (Fig. 4);

Step 6 - further, it is advisable to determine the ability to export the planned volume of MSW by available vehicles and give an estimate of the need for additional vehicles (garbage trucks), taking into account the schedule of flights (Fig. 5);

Step 7 - the required number of vehicles is determined for the implementation of operational tasks in full and an assessment of the financial costs of their purchase is given;

Step 8 - identification of sources of financing;

Step 9 - the definition and calculation of additional areas of attracting cash flows into the organization and increasing its level of profitability.

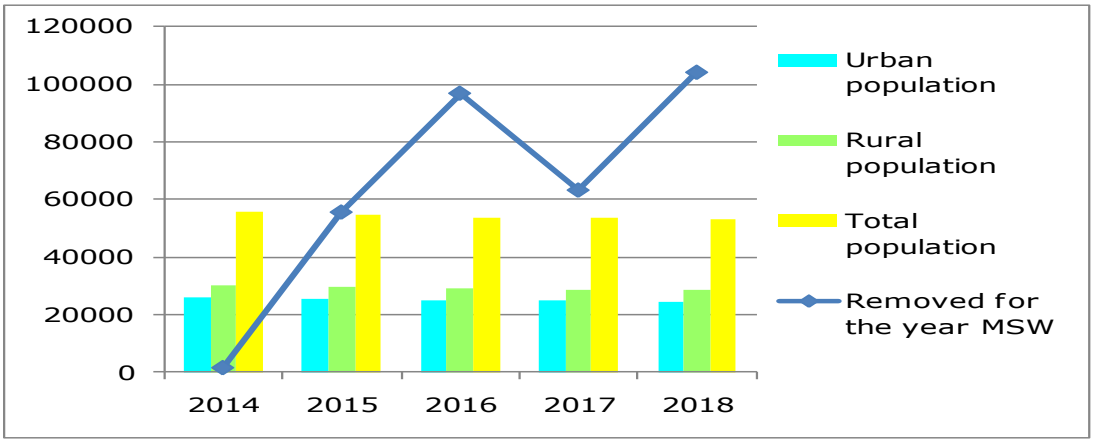

Fig. 2. Dynamics of the initial indicators for the formation of a dataset for the purpose of forecasting and planning the results of operational activities at the municipal level, considering the 2019 of municipal solid waste reform

Source: Author

Consider this issue on the example of PJSC "Clean City" Zernogradsky district of the Rostov region. Fig. 2 provides information on the volumes of MSW in the Zernogradsky municipal district [11]. According to the municipal statistics on 01.01. In 2018, the population of Zernogradsk district is 53,119 people [10]. Based on the data presented in Figure 2, it can be concluded that, on average, in Zernogradsky district there is 1.96 cubic meters exported of municipal solid waste per 1 inhabitant. Since there are no official statistical data for 2018 at the time of this document, it is possible to determine the volume of exported MSW in 2018 based on the average value calculation. Thus, the estimated value of exported of municipal solid waste in 2018 is 103, 97 thousand cubic meters.

Next, we present the predicted values for the population and the volume of municipal solid waste removed during the year (thousand cubic meters). We predict population size using trend models (Fig. 3). The forecast period is 3 years. A second-order polynomial was chosen as a function for the prediction, the materiality and reliability of the model was tested using a coefficient of determination, the value of which is 98.78%.

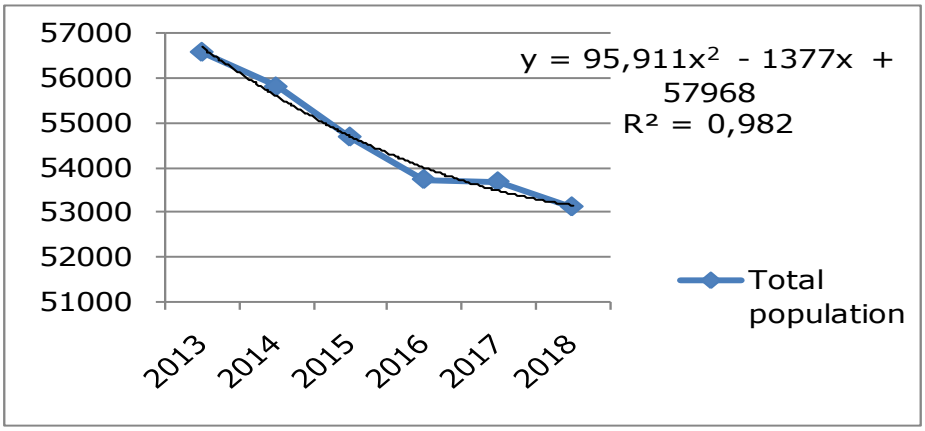

Fig. 3 Polynomial function of the indicator "Population" for Zernogradsk district
Source: Author

The results of the forecast of the population and volumes exported for the year of MSW are presented in table 1.

Table 1 Forecasting of the population and volumes of MSW exported during the year in the Zernogradsky municipal district, thousands of cubic meters

Period	Population, man	Waste for the year MSW, thousand cubic meters.
2013	56589	326,50
2014	55812	1,51
2015	54686	55,47
2016	53733	96,70
2017	53681	63,10
2018	53119	103,97
2019	**52856,09**	**103,45**
2020	**52744,98**	**103,23**
2021	**52777,70**	**103,30**
2022	**52954,26**	**103,64**

Source: Author

In accordance with Decree No. 85/127 of December 20, 201 “On Establishing a Unified Tariff for the Service of the Regional Operator for Solid Municipal Waste Management LLC EcoCenter” (TIN 3444177534) in the area of activity of the Salsk Intermunicipal Ecological Recycling Complex for 2019 [12] A single tariff was set for the service of a regional operator for municipal solid waste management, EcoCenter LLC (TIN 3444177534), which was used further in the calculations.

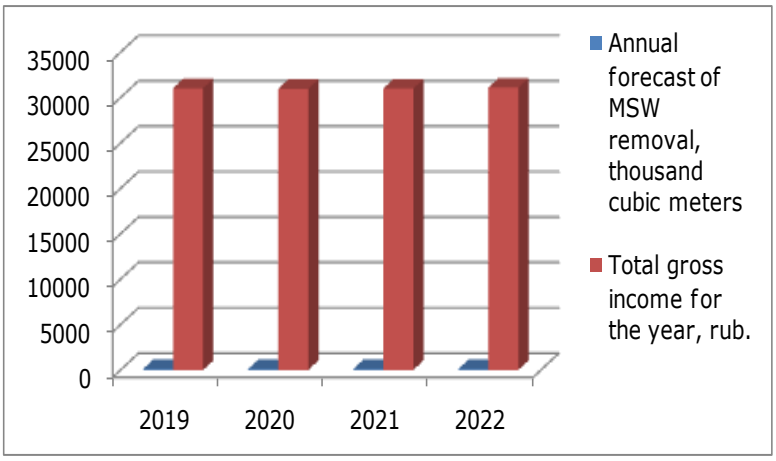

Fig. 4. Calculation of forecast values from operational activities at the municipal level

Source: Author

For our organization, the calculation of the planned number of flights was made based on the minimum and maximum possible number of flights per day, considering the compression ratio, which was adopted at the level of 1.2 points. The calculations are presented based on the planned number of flights 3 minimum - 4 maximum - Fig. 5.

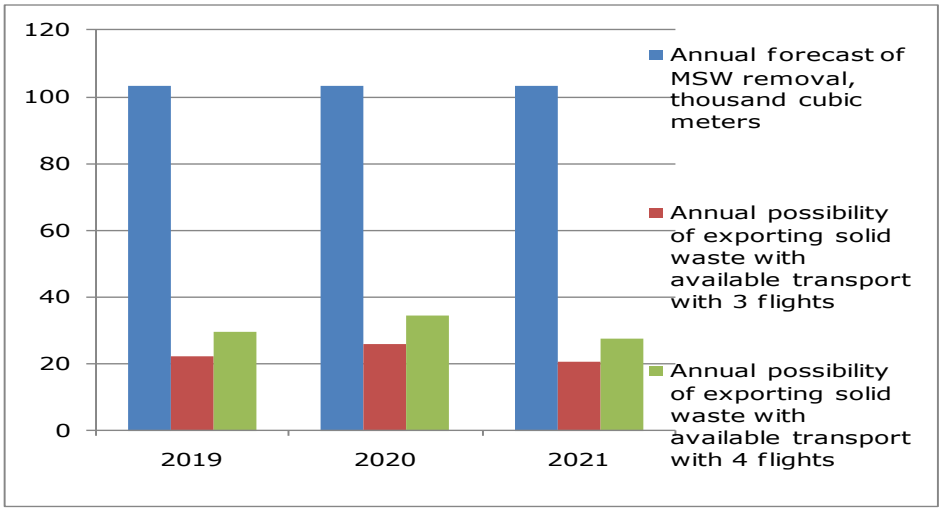

Fig. 5. The ratio of annual demand and the ability to solve operational problems at the level of the municipality

Source: Author

The figure shows that the organization does not have the capacity of existing production resources and requires the purchase of additional vehicles in an amount of from 3 to 7 units, depending on the compression ratio and flight schedule. In order to fully implement the tasks, set for the export of MSW in the assigned territory of the organization, it will be necessary to purchase additionally from 4 to 7 vehicles, the average market value is 1.7 million rubles, total costs - from 7 million rubles. up to 11.3 million rubles. Depends on the choice of vehicle type, the number of flights per day and the implementation of the compression ratio. Plyaskina N.I., Kharitonov V.N. [6] note that the most effective management methods of MSW are associated with the recycling process and alternative methods of MSW recycling, which in turn implies conducting separate collection of garbage, organizing relevant container sites. The organization of container sites as a task is delegated to the municipal level, which also leads to the need to determine the amount of funding in this area and search for sources of funding. The most common way to manage MSW in the Russian Federation and EU countries is the method of disposal of MSW. Other types of MSW management include incineration, pyrolysis, bioremediation and biogas plants, composting, recycling and SLFs [4] If we consider the implementation of the pyrolysis processing of MSW, we should note a number of

difficult moments, namely the high cost of pyrolysis stations, the complexity and danger of implementing the pyrolysis processing of MSW, the need to solve new management tasks related to solving the issues of pyrolysis products and the overall assessment of the pyrolysis station profitability. Thus, the effective implementation of management decisions in the collection, processing, storage and disposal of MSW at the municipal level requires substantial amounts of funding, as well as high-level specialists who can make financial and economic calculations in the planning and forecasting of volumes of MSW exported.

3. RESULTS

As a result of the study, the following conclusions were made. First, the implementation of the process of collection and disposal of MSW in the Russian Federation is characterized by deficiencies and lack of infrastructure infrastructure at the regional and municipal level, insufficient development and validity of tariff formation for export of MSW, problems in the formation of regulatory values for MSW export for rural and urban areas. Secondly, the problems listed at the tactical level have led to the difficulty of implementing operational tasks. As a result, the municipal organizations directly responsible for the performance of this function in the Russian Federation are organizations called “Clean City”, faced with a set of systemic problems in the field of organization, planning and financing of both their operational and strategic activities. Thirdly, in the framework of this study, a decision-making algorithm for management of MSW at the municipal level has been proposed, which will at the initial stage determine the existing resource potential of the organization and identify the necessary project initiatives for solving operational problems in the context of reforming the municipal solid waste management system.

4. CONCLUSION

Insufficient coherence of actions on the part of state authorities and the population, the lack of effective management methods for municipal solid waste, problems of financing projects for the storage, processing and disposal of MSW are a pressing problem not only for the Russian Federation, but also for other countries (Jordan [9], Slovenia and Croatia [2], Indonesia [3], Italy [8], India [5], etc.). It should be noted that pollution with solid municipal waste in rural areas is of relevance since it is the rural area that is the “receiving” side of the garbage dump because of the rapid processes of urbanization and urban growth. [20]. At the same time, the management of municipal solid industrial and medical waste is of importance. Currently, this issue has not found an effective solution. In this context, the proposed algorithm can be improved and refined to meet the specificity of municipal solid waste and from the position of the need to address design initiatives in operational activities.

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PART II - RISK MANAGEMENT, SAFETY AT WORK AND POPULATION HEALTH

Safety at Work at Height in Construction

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Abstract

In the last decade, there has been an increase in the number of industrial accidents with many casualties and significant material losses. According to the International organization for labor protection (ILO), as a result of industrial accidents in the world in 2018, about 350,000 people died, more than 2 million people died from occupational diseases. As for injuries without lethal outcome, the statistics are even more depressing: 330 million workers are injured every year, 160 million are ill with occupational diseases [13].

In Russia in 2017, 25,400 people suffered from accidents at work, including 1138 people with fatal outcome, the number of people with occupational disease established in the reporting year was 4756 people [1].

Out of 136435 registered enterprises in the Russian Federation, 11454 are construction companies. Construction all over the world is one of the dangerous anthropogenic factors affecting the environment, a source of irreparable negative consequences for the ecological balance of ecosystems [14]. And at the same time, the construction industry is important in the development of the national economy: the economic efficiency of related sectors of the economy is largely ensured by the intensive development of construction. Construction meets the rapidly growing needs of economic systems and meets the demands of conventional construction, renovation, operation and dismantling of buildings in all countries.

Keywords: risk factors, occupational injuries at work at height in construction, the conditions of construction labor, occupational safety and health at work at height in construction, measures to improve working conditions, monitoring of working conditions, harmful and dangerous working conditions, temporary disability

1 INTRODUCTION

The construction industry is important in the development of the national economy: the economic efficiency of related sectors of the economy is largely ensured by the intensive development of construction. Construction meets the rapidly growing needs of economic systems and meets the demands of conventional construction, renovation, operation and dismantling of buildings in all countries. The successful implementation of all construction tasks depends largely on the preparation of the technological sequence of certain types of work, which includes: engineering training; work on the development of pits and trenches, with the movement of soil and installation of the Foundation; the construction of buildings and structures; finishing work. Implementation of all stages of construction requires quite complex organizational, technical operations and increased attention to safety.

In modern conditions of formation of market economy and ensuring sustainable development in Russia new requirements to the organization of work at the enterprises are imposed. In this regard, an important issue in accordance with the conventions and recommendations of the International Labour Organization is the creation of effective working conditions. The conditions of work depend on the result of work, total life expectancy, working capacity, physical health, the period of social activity.

The purpose of this work is to analyze the main causes of injuries and new rules when working at height in construction, as well as the assessment of professional risk in the performance of finishing works.

2 THEORY

In the last decade, there has been an increase in the number of industrial accidents with many casualties and significant material losses. According to the International organization for labor protection (ILO), as a result of industrial accidents in the world in 2018, about 350,000 people died, more than 2

million people died from occupational diseases. As for injuries without lethal outcome, the statistics are even more depressing: 330 million workers are injured every year, 160 million are ill with occupational diseases [13].

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Out of 136435 registered enterprises in the Russian Federation, 11454 are construction companies. Construction all over the world is one of the dangerous anthropogenic factors affecting the environment, a source of irreparable negative consequences for the ecological balance of ecosystems [14]. And at the same time, the construction industry is important in the development of the national economy: the economic efficiency of related sectors of the economy is largely ensured by the intensive development of construction. Construction meets the rapidly growing needs of economic systems and meets the demands of conventional construction, renovation, operation and dismantling of buildings in all countries. In accordance with the concept of sustainable development, a comprehensive indicator of sustainable development of the object includes environmental and social indicators, including occupational safety and occupational risk assessment, as well as technical and functional indicators that affect each other.

3 DATA AND METHODS

The successful implementation of all construction tasks depends largely on the preparation of the technological sequence of certain types of work, which includes: engineering training; work on the development of pits and trenches, with the movement of soil and installation of the Foundation; the construction of buildings and structures; finishing work. Implementation of all stages of construction requires quite complex organizational, technical operations and increased attention to safety.

According to Rosstat in the construction industry, the number of victims with disability for one working day in 2017 amounted to 2,100 people, of whom 200 people died, 215 workers received occupational diseases [1]. The number of deaths due to accidents in the construction industry amounted to 23.6 % of the total number of fatalities.

Analysis of the typology of accidents with severe consequences shows that in 2017, almost every fourth employee was seriously injured or died as a result of falling from a height, and every fifth – as a result of the impact of moving, flying, rotating objects, machine parts [4].

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Analysis of the typology of accidents with severe consequences shows that in 2017, almost every fourth employee was seriously injured or died as a result of falling from a height, and every fifth – as a result of the impact of moving, flying, rotating objects, machine parts [4].

Falling from a height is a serious professional risk in several professions in the construction industry. Such dangerous professions include the work of masons, roofers, installers, concrete workers, finishing work. Falling from a height causes injuries and deaths.

Falling from a height is one of the main causes of industrial injuries and accidents at work in construction. The main causes of industrial injuries in the performance of work at height are associated with poor content and shortcomings in the organization of workplaces, faulty condition of forests, scaffolding, devices, protective equipment and tools, structural defects and malfunction of construction machines, mechanisms and equipment; insufficient qualification of workers, the non-use of personal protective equipment, as well as the lack of constant and effective control of safety, shortcomings in the training of workers for labor protection, etc. Analysis of the causes of severe injuries in construction shows that up

to 70 % of all cases of severe injury to workers are organizational reasons and are associated with the shortcomings of direct managers of works on construction sites [15].

Injuries in the performance of work at height in the whole of the Russian Federation occupies a significant share. Therefore, in 2015 the Ministry labour and social protection of the Russian Federation were tightened safety requirements in the performance of such work. These requirements are spelled out in the "Rules on labor protection at work at height" (Rules) [16]. In them, the legislator, in addition to changing the parameters of the height, which increased from 1.3 to 1.8 m, added new organizational and technical and technological measures when working at an altitude [17]. Note that employers have the right to set their own safety standards when working at height, if they do not contradict the new regulations. Many large companies have left the norm of 1.3 meters, thus strengthening the requirements for work at a height for themselves and their contractors.

The new Rules significantly expanded the requirements for medical examinations and training of workers when working at height. If earlier to works at height the workers who passed medical examination without contraindications to performance of works at height were allowed, in new Rules it is specified on need to pass obligatory preliminary and periodic medical examinations.

The requirements for the training of workers engaged in work at height have been tightened. In addition to instructions, now the employee must have a qualification, the level of which is confirmed by the document on vocational education and qualifications. The new rules introduce three groups of safety workers, depending on the specific type of work at height. Periodic training of workers of 1 and 2 groups in safe methods and methods of performance of work at height is carried out at least 1 time in 3 years, and 3 groups at least 1 time in 5 years.

In accordance with the new Rules, the employer must organize technical, technological and organizational activities prior to the start of work at height. These activities include the development of a plan to produce works at height, approval of technological maps for the production of works, fencing of the place of production of works, hanging warning and prescribing posters or signs, the use of collective and individual protection.

No safety concept and no safety action plan will operate:

— without the allocation of specific responsibilities among specific people; — without the identification of specific tasks to be completed by a certain date.

The concept of safety and the plan of actions for safety measures should be consistently brought to all workers their safety is urged to provide this plan [10]. A significant innovation is that the employer appoints persons responsible for the organization and safe conduct of work at height, for the issuance of the work permit, as well as conducting maintenance and periodic inspection of personal protective equipment.

The new Rules include labor protection requirements for the performance of certain types of construction and installation works. Construction and installation works include the following types of work: work at height in a confined space, glass work, concrete work, stonework, finishing work, etc.

Table 1 - Possible hazards (risks) during finishing works arising from hazardous and harmful production factors

Hazardous and harmful production factors [18]	**Hazards (risk) [19]**
Location of the workplace near the height difference of 1.8 m or more;	Fall from height
Increased dust and gas content of the working area air	Injury of the respiratory tract, the eye, poisoning, allergies, drop
Fires and explosions caused by paints containing flammable solvents,	Burns, poisoning, falling from a height, death
Sharp crumbs, burrs and roughness on the treated surface;	Wounds, cuts
Increased voltage in the electrical circuit	Electrical shock
Insufficient illumination of the working area.	Falling from a height, injuries, cuts

4 METHODS

Finishing works that give the building or structure a finished look and protect the structure from moisture, corrosion, mechanical damage, are the final stage of construction. These include plastering, cladding, painting, glass work.

In this study, an analysis of occupational risks associated with exposure to hazardous and harmful production factors in the performance of finishing works was carried out.

The main operational steps to be performed for finishing work, and possible danger (risk), given in table.1.

A comprehensive assessment of working conditions on the basis of special studies of the factors of the working environment is carried out in the certification of workplaces. According to the normative documentation, certification of workplaces on working conditions is carried out once every 5 years by a special Commission, which includes the main specialists of the enterprise, employees of personnel departments, labor protection, medical workers. Studies of sanitary and hygienic factors of the working environment, the severity and intensity of the labor process are carried out at specific workplaces through laboratory studies, instrumental measurements and calculations. Results of instrumental measurements of parameters of harmful and dangerous production factors are made out by protocols and are entered in cards of certification of working conditions at a workplace. Further analysis and comparison will be based on maps of working conditions in the workplace.

5 RESULTS

Risk assessment (R) of harm (loss) to health by analyzing the probability and consequences of exposure to hazardous and harmful production factors during finishing works was performed using the method of semi-quantitative risk assessment [8] and is presented in table 2.

In addition to the harmful and dangerous production factors described in table 1, the worker is affected by noise levels, increased levels of vibration, heating and cooling microclimate and chemical factors. Assessment of occupational risk from physical and chemical factors by indirect method, based on the class of working conditions, requires a special assessment of working conditions, the results of which are presented in tables 3 and 4.

After analyzing these data, we can say that the main danger for the manifestation of injuries on the construction site during finishing work is the danger of falling from a height. The increase in occupational risk is affected by dustiness of the working area, poor lighting, malfunction of scaffolding, lack of collective and individual protection. Low qualification of workers and low level of culture in occupational safety is the main cause of injuries in the construction industry. The level of risk (R) as a result of the assessment of occupational risk by semi-quantitative method for workers in finishing work is high enough when working at height and is 72 points. The probability of falling from the height of the employee leads to the loss of working capacity for 1 day or more, up to death.

Table 2 - Semi-quantitative assessment of the risk of harm (loss) to health

Hazards (risk)*	Severity (p) on a 9-point system**	Category of accident***	the Likelihood of an accident (W) 9-point system**	Risk (R) on 80 point system
the fall of a person from a height(1,2, 3,6)	injury (8 - 2)	severe	9 - 6	72 - 12
	death (9)	severe	5 -3	45 - 27
injury (2,6)	injuries (9 – 2)	severe-mild	9 - 7	81 - 14
	eye injury (8 – 3)	severe-mild	7 - 4	56 - 12
	choking	severe-mild	9-7	81-14
	injury of the respiratory tract (8 – 2)	severe-mild	9-6	72-12
injury (3)	death (9)	тяжелый	5 - 3	45 - 27
	burns (8-5)	severe-mild	8-5	64-25
	poisoning (8-6)	severe-mild	8-4	64-24
injury (5)	death (9)	severe	3 - 1	27 - 9
	burns (8-5)	severe	8 - 5	64 - 25

Hazards (risk)*	Severity (p) on a 9-point system**	Category of accident***	the Likelihood of an accident (W) 9-point system**	Risk (R) on 80 point system
	electrocution (4 – 2)	severe-mild	4 - 2	16 - 4
injury (2,3)	cancer (8)	severe	9-6	72-48
	death (9)	severe	3-1	27-9
	skin rash, dermatitis, allergy (4 – 3)	severe-mild	7 - 6	28 - 18
	* in brackets – the number of the description the working action at the table.1; ** at the table.1 based on medical indications [2] *** On determining the severity of health damage from industrial accidents. The Order of The Ministry Of Health. Russia of February 24, 2005 №160			

Thus, the production of finishing works are potentially dangerous works, as it is associated with technological processes and work at height. To prevent the employee from falling from a height, it is necessary for the employer to carry out technical, technological and organizational measures before the start of finishing work at a height. Workers performing work at a height of finishing work, must have a qualification corresponding to the nature of the work performed, the level of which is confirmed by the document on vocational education and qualifications. Occupational health and safety specialists should monitor those responsible for working at height and their training.

Table 3 - Indirect method of risk assessment based on the class of working conditions

Factor	Reason	Recommendations SanPiN [20]	Amount of risk
Physical factors			
The noise is periodic, impulsive	Equipment, earth moving machines	(> 85 dB)	*Risks in accordance with the class of working conditions (table. 3)*
Microclimate			
Temperature in the working environment in the open area	Temperature (-40 …+40 ºC)		
The heating microclimate		18-31 °C	
A cooling microclimate		-30…60°C	
Natural light: Coefficient of natural light, KEO, %		0,6…< 0,1	
Artificial lighting: Illumination of the working surface (E, lx) for the categories of visual works:		< Eн	
Vibration local (on hands)	Work with mechanical equipment	up to 12 maximum permissible level	
Chemical factors that can lead to poisoning, choking, allergies, skin and other infectious diseases			
Chemicals	Dust and gases from preparatory and painting works		*Risks in accordance with the class of working conditions (table. Three)*
Dust		up to 10 maximum permissible concentrations	
Harmful substances of hazard class 1-2		up to 20 maximum permissible concentrations	
Carcinogen		up to 10 maximum permissible concentrations	

Factor	Reason	Recommendations SanPiN [20]	Amount of risk
Allergens		up to 10 maximum permissible concentrations	
Ergonomic factors			
Workplace	Work standing		
Working posture	Forced posture	Periodic presence in an uncomfortable, fixed position 25...50% or more of the shift time	
Methods of work	Non-monotonic		

Table 4 - Dependence of occupational risk on classes of working conditions (P 2.2.2006-05)

Class of conditions labor management P 2.2.2006-05	index occupational disease	The category of professional risk	Urgency of risk reduction measures
optimal - 1	-	There is no risk	No action required
permissible - 2	< 0,05	Negligible (tolerable) risk	No action is required, but vulnerable persons need additional protection *
harmful - 3.1	0,05 - 0,11	Small (moderate) risk	Measures are required to risk reduction
harmful - 3.2	0,12 - 0,24	Average (significant) risk	Risk reduction measures are required in a timely manner
harmful - 3.3	0,25 - 0,49	High (intolerable) risk	Urgent needs risk reduction measures
harmful - 3.4	0,5 - 1,0	Very high (intolerable) risk	Work cannot be started or continued until risk reduction
Dangerous (extreme)	> 1,0	Ultra-high risk and risk to life inherent in the profession	Work should be carried out only under special regulations **

* Vulnerable groups of workers include minors, pregnant women, nursing mothers, disabled persons.
** Departmental, branch or professional regulations of works with monitoring of the functional state of the organism of the worker before or during change.

Instructing of workers of the enterprises shall be carried out according to GOST 12.0.004-90 "the Organization of training of safety of work". Programs of instructing are developed by specialists in labor protection considering requirements of standards, rules, norms, taking into account features of work at height in construction. O make an entry in the log of instructions at the workplace, as well as in the documents of employment (personal card). An indirect method of risk assessment based on the results of a special assessment of working conditions will make it possible to influence the organization and improvement of the workplace of workers in finishing works related to technological and organizational functions. The proposed measures will reduce injuries when falling from a height during finishing works in construction organizations.

6 SUMMARY

1. Statistics on the level of industrial injuries in the construction industry in Russia indicates a lack of motivation and responsibility of employers for serious attitudes to safety.

2. The new rules of work at height tighten the requirements of work at height and increase the responsibility of employers for labor protection.

3. Improving professional education, skills and culture in the safety of work in the construction industry will reduce injuries when falling from a height.

4. It is necessary to direct all means on financing of actions for labor protection to improvement of working conditions and on training of workers in methods of safe work.

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The Contribution of Weather and Climatic Conditions in Shaping Population Health

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Abstract

Objective: to assess the contribution of natural and climatic conditions to the formation of health of the population living in the third climatic zone of Russia (compared to the second zone); the relationship between the daily calls for emergency medical care of the adult population in connection with diseases of the circulatory system and daily levels of meteorological parameters. The object of the study was the adult population living in different climatic zones of Russia with different winter temperatures (-9,0 °C; -18,0 °C). The contribution of the climate factor was assessed by calculating the hypothetical (standardized) mortality rate (SIR) for cerebrovascular diseases (CVB) according to the international classification of diseases (ICD-X). The index method was used to assess the contribution of the studied factor to the formation of public health. Our research has shown that living in natural and climatic conditions with low winter temperatures contributes to an increase in the mortality rate of men from cerebrovascular diseases (CVB).

Keywords: climatic zone, socio-economic characteristics of the region, age groups, mortality of rural population, challenges to emergency medical care.

1 INTRODUCTION

Well-being, and moreover, health, is often associated with weather and climatic conditions: changes in air temperature, air humidity, fluctuations in atmospheric pressure [1-14]. This is especially true for people suffering from chronic diseases of the circulatory system and respiratory system. Although it is known that the causes of these diseases often lie in the biological and social sphere, it is necessary to consider other factors that can provoke their exacerbation and affect everywhere and constantly - these are meteorological factors. In addition to weather characteristics in winter, it should be borne in mind that a significant territory of Russia is in the Urals, Siberia, the Far East, where winter temperatures reach extremely low values.

The territory of Russia includes various climatic zones, with their inherent complex of factors: temperature, wind speed, snow cover, etc. [15-17].

Permanent residence in the Northern regions of Russia with a sharp reduction in daylight hours in the autumn-winter period, a long period of stable snow cover cause stress adaptation mechanisms of the human body and the human body cannot be indifferent to it. This factor is considered by physiologists as a stress factor that requires the mobilization of all resources of the body. As a result of the long-term interaction of the human body with the environment adaptation occurs with the formation of a certain level of homeostatic regulation of body functions. At high intensity of climatic factors, maladaptation may occur, accompanied by the development of pathological conditions [18].

The aim of the work is to assess: 1) the contribution of natural and climatic conditions to the formation of health of the population living in the third climatic zone of Russia; 2) the relationship between the daily calls for emergency medical care of the adult population of the Moscow region in connection with diseases of the circulatory system (hypertension, coronary heart disease, vegetative-vascular dystonia) and daily levels of individual meteorological parameters (temperature, humidity) and ozone concentrations in the surface layer of the atmosphere.

The aim of the work is to assess: 1) the contribution of natural and climatic conditions to the formation of health of the population living in the third climatic zone of Russia; 2) the relationship between the daily calls for emergency medical care of the adult population of a town near Moscow in connection with diseases of the circulatory system (hypertension, coronary heart disease, vegetative-vascular

dystonia) and daily levels of individual meteorological parameters (temperature, humidity) and ozone concentrations in the surface layer of the atmosphere.

The objects of the study were: 1) the population of the subjects of Russia II and III climatic zones; 2) the settlement of the Moscow region (II climatic zone) to assess the impact of meteorological parameters and geomagnetic background on the health of the population (75 thousand people).

Materials and methods. To achieve the objectives of the study with the use of mathematical-statistical methods.

For climatic zoning, the division of the territory of Russia into zones is used depending on the combination of low temperatures and wind speed characteristic of different regions of Russia (table 1).

Table 1 – Climatic zoning of the territory of Russia in the cold period of the year1

Climate zone	Temperature air in winter months, °C	Average wind speed in winter months, m/s
III	-18	3,6
II-I	-9,7	6,0

The climate of the region determines the degree of cooling of the human body when it is in the open area. This principle of climatic zoning is used as a criterion for the harmful effects of cooling on the human body when working in the open area in the cold season, in the development of clothes for protection from the cold, determining the permissible time of stay of a person in the cold, used in the Technical regulations of the Customs Union "On the safety of personal protective equipment" (TR CU 019/2011).

The basis for the allocation of climatic zones in these regulations are the features of climate, expressed in the form of a set of conditions that affect the processes of heat exchange, and subjectively, the perception of climate comfort [18].

Natural and climatic conditions of the III and II climatic zones of Russia (Novosibirsk and Penza regions) in the cold period of the year differ in terms of average annual temperature (more than -5°C), wind speed in winter (6.0 m/s against 3.6 m/s), the average temperature in January (-18°C against -9.8°C), which characterizes the features of the 3rd and 2nd climatic zones of the Russian Federation. In the Novosibirsk region climatic conditions are characterized by long winters (up to 180 days), low winter temperatures (up to -46°C) with a significant wind speed.

These areas are comparable in several characteristics: the national composition is mainly represented by the Russian population: 93.1% and 86.8% respectively, socio-economic characteristics are also comparable. Socio-economic indicators of the Novosibirsk and Penza regions are presented in table. 2.

Table 2 - Main socio-economic characteristics of the Novosibirsk and Penza regions in 2017[2]

Socio-economic characteristics	III climate zone (Novosibirsk region)	II climatic zone (Penza region)
Population (thousand people))	2788,8	1331,7
Average per capita cash income (per month), RUB	25313	21611
The cost of a fixed set of consumer goods and services (at the end of the year): RUB.	7764	13073,5
Unemployment rate, percent	6,0	4,5
Number of doctors, people (per 10,000 population)	53,1	42,0
Number of persons with higher and incomplete higher education (per 1000 population)	291	229

[1] Source: Technical regulation of the Customs Union TR CU 019/2011 "On the safety of personal protective equipment", approved. The decision of the Commission of the Customs Union of December 9, 2011 N 878.
[2] Federal state statistics service. region of Russia. The main characteristics of the subjects of the Russian Federation. – 2018.

To solve this problem, the official data of Rosstat were used: the Russian statistical Yearbook 2013-2017, information and analytical materials: regional data on the population of the Russian Federation by sex and age, Statistical Bulletin "Socio-economic indicators of poverty, Regions of Russia. Socio-economic indicators, statistical Bulletin "Cash incomes and expenditures of the population", Demographic Yearbook of Russia 2017.

The contribution of the climate factor was calculated based on additional deaths from causes, the formation of which may be the result of exposure to cold and prolonged winter [19-21]. Deaths from cerebrovascular diseases were analyzed.

The method of standardization by age, with the subsequent calculation of the share of the influence of factors of age structure and intensity of indicators, allows to solve the task and to expand the analytical capabilities of the overall mortality rates. Age-specific indicators of the rural population of the Novosibirsk and Penza regions (men and women) and age-specific mortality rates from these causes of the study (for 2017) were used for calculations. Statistical evaluation of the presence of "impact – death" was carried out by calculating the standardized relative risk of SIR (standardized incident ratio), with 95% confidence intervals (CI) [21]. The standardized relative risk (SIR) of adverse health effects was calculated as the ratio of the actual number of cases among the exposed persons to their expected number, if risk indicators in the control are taken as the standard. The formula was used to calculate 95% CI of the relative risk index:

$$95\%\ CI = \exp \ln RR \pm 1{,}96\sigma\ (\ln RR).$$

2 RESULTS

Mortality coefficient from CVB, as well as the age structure of the population of the Penza and Novosibirsk regions are presented in table 3. It is obvious that in the Novosibirsk region the proportion of persons 60 years and older was slightly lower than in the Penza region, therefore, structural changes could adjust the mortality rate from cerebrovascular diseases (CVB).

Table 3 - Age structure and mortality from CVB in men in rural areas of Novosibirsk and Penza regions (2017.)

The age	The age structure of the rural male population		CSM from CVB (per 1000 population)	
	Novosibirsk region	Penza region	Novosibirsk region	Penza region
20 -29	0,18	0,18	0,08	0,07
30 – 39	0,2	0,18	0,19	0,14
40 – 49	0,18	0,19	0,48	0,43
50 - 59	0,25	0,24	1,5	1,5
60 - 69	0,13	0,14	4,7	3,12
70 -79	0,06	0,08	14,9	8,0
Итого	**∑1,0**	**∑1,0**	**2,04**	**1,52**

The differences in mortality rates of the population living in different climatic conditions are obvious. But it is also clear that in the more northern region, the proportion of older persons is lower. This, of course, affects the overall mortality rate from circulatory system diseases, including cerebrovascular diseases.

The standardized (hypothetical) mortality rate (SOR) of the conditional population group was based on their assumption that the age structure of the population of the Penza region remains, but the death rates of workers in each age group correspond to the population of the third climate zone, i.e. population of the Novosibirsk region.

The obtained value of the standardized death rate from CVD (COP = 2,3, 95% CI 1.5-2.7) is higher than the mortality rate obtained for both the rural male population of the Penza region and the corresponding population of the Novosibirsk region (1.52 <2.04; 2, 04 <2,3). Age-related structural differences and differences in intensive indicators contribute to the final actual difference in mortality rates of the rural male population of the Penza and Novosibirsk regions of Russia.

The overall difference between the death rates of rural male tsv on the population of the two regions is 0.53% 0 (taken as 100%). The difference between the hypothetical death rate from the CVD and the

actual death rate obtained for the rural population of the Penza region is (2.3% 0 - 1.52% 0 = 0.78% 0) and reflects the influence of climate (147.2%).

Comparison of the death rate of the male population of the Novosibirsk region compared with the hypothetical mortality rate reflects the contribution of age-related structural differences among the male population of rural areas in two regions of Russia. The difference between the real mortality rate of the rural population of the Novosibirsk region and the hypothetical indicator was: 2.05% 0-2.3% 0 = -0.25% 0. Those. the influence of structural age differences between the subjects of Russia located in the third and second climatic zones is an inhibiting factor and amounts to (-47.2).

Table - 4 Percentage of the impact of structural differences and mortality rates on the differences in mortality rates of the population from the CVD of different climatic zones (Climate Belt II and Climate Belt III).

CVD	Difference in mortality rates	Impact share (%)	
		Age structure	Climatic factor
	0,53 ‰	-0,25 ‰	0,78 ‰
	100,0 %	-47,2	147,2

During the observation period (0.5 years), 2,800 calls to the emergency medical service were registered in the Moscow region in connection with hypertension, coronary heart disease and vegetative-vascular dystonia. More than 70% (71%) of applicants were 60 years old and older. Almost all weather characteristics correlated with each other. For example, the correlation coefficient between the concentration of ozone in the atmospheric surface layer and air temperature was -0.5, i.e. the higher the air temperature (in winter), the lower the concentration of ozone in the surface layer of the atmosphere.

In the cold period (November-December), with a decrease in air temperature by 1 ° C, the number of emergency medical care calls increased by 1.25%. The correlation coefficient between a decrease in air temperature and an increase in blood pressure in patients with hypertension was moderate and negative (r = -0.64) during the cold winter period (November, December) of observation: the lower the air temperature, the more urgent medical care calls were recorded. . The data obtained are reliable with a probability of 99.9%.

The geomagnetic background made almost no adjustments to the well-being of the population. The strength of the connection between the magnetic background and ambulance calls was insignificant - the correlation coefficient was only -0.02.

Thus, it was shown that lowering the temperature of atmospheric air during the winter period by 1 ℃ contributes to an increase in the number of ambulance calls by 1.25% due to circulatory system diseases. Living on a territory with a long cold winter (III climatic zone of Russia) contributes to the formation of higher mortality rates from cerebrovascular diseases, respiratory diseases in the population, compared with the population living in the II climatic zone of Russia.

3 FINDINGS

1. Among the meteorological characteristics of the most significant impact on the rate of ambulance calls has air temperature. Lowering the temperature of the atmospheric air in winter by 1 ℃ contributes to an increase in the number of ambulance calls by 1.25% (g = -0.64, P = 99.9).

2. Among those who applied for emergency medical care more than 70% make up a person 60 years or more.

3. Correlation between the indicators of geomagnetic background and ambulance calls were not identified.

4. It was revealed that the contribution of the climatic factor (III climatic zone of Russia) to the formation of differences in the mortality rates of the male and female rural population of the Novosibirsk region, compared with similar indicators obtained for the population of the Penza region (II climatic zone of Russia), due to cerebrovascular diseases and respiratory diseases in the age range from 20 to 80 years, is leading, while the influence of age differences (structural) of the compared areas has the opposite effect, reducing them, because in the structure of the population of the Novosibirsk region, the proportion of persons 60 years and older is significantly less.

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PART III - ECONOMY AND ECOLOGY IN TERMS OF GLOBAL BUSINESS ENVIRONMENT

Disclosure of Environmental Responsibility Information in the Corporate Reporting of Economic Entities

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Abstract

This article examines the topical issues within the corporate, social, and environmental responsibility reporting of economic entities. It focuses on studying the users of such reporting. The article presents relevant classification of users of environmental and social reporting information according to important characteristics amid ongoing digitization and globalization. After reviewing the results of a survey conducted among the employees of financial and accounting functions in medium-sized companies about environmental and social responsibility reporting, the authors concluded that the current situation favours further development of such reporting.

Keywords: Corporate social responsibility, environmental responsibility, business model, financial reporting, environmental reporting, integrated reporting, users of reporting information.

1 INTRODUCTION

In many countries, environmental disasters lead to social problems related to the contamination of large areas of the human and animal habitat. Sokolov, a classic of Russian accounting theory, has already identified five paradigms in accounting theory, including a sociological one [1]. It is the sociological theory viewed in a broader sense that encompasses the issues of environmental responsibility. According to Eremeeva, social and environmental issues are at the intersection of many theories, while "environmental accounting is an urgent modern requirement, though it has strong historical roots" [2]. However, the dramatic changes in accounting (a vivid example of which are changes in International Financial Reporting Standards) and the emergence of non-financial reporting are accompanied by conceptual, methodological and tutorial discussions and disputes. The issue of corporate social responsibility commands attention of the entire economic science community.

1.1 Literature review

The scope, concept, methodology and form for presenting the corporate social responsibility of economic entities in reporting have long caused heated debate among scientists, businessmen, those who create the economic information space and those who use it. Environmental responsibility is generally perceived as part of sociological accounting theory, the proponents of which include Tinker [3], Littleton and Zimmerman [4], Bedford [5] and others. The EU has adopted an approach to corporate social responsibility in terms of the internal and external areas of responsibility of economic entities [6]. The division of corporate social responsibility into two dimensions, as proposed by the European Union in 2001 [7], still provides a relevant structure. Internal environmental issues directly relate to matters of managing the impact of an economic entity's own activities on the environment, and external issues refer to the impact on the global environment. According to the European Commission, the corporate social responsibility is defined as "the responsibility of enterprises for their impact on society" [6]. Quite often, three components of sustainable development, including economic (profit), social (people) and environmental (planet) components, are identified as parts of corporate social responsibility.

Kuzubov, Danilenko, & Demchuk [8] provide an important review of the scientific literature on corporate social responsibility and related reporting. The authors used the Scopus database to analyze the academic research on this topic in business, management and accounting journals for the period of 1977–2015. This study revealed a significant increase in publications from 2005 to 2015, on the one hand, and many unresolved issues, on the other. In the area of accounting, most of the questions have been raised by the clash between the profit maximization theory [9] and stakeholder theory, which implies achieving a balance between the interests of shareholders and those of other

stakeholders [10]. Researchers note that the existence of different reporting standards for corporate social responsibility impedes mutual understanding both between the economic entities and between these entities and users of reporting information, even though the reporting in this area extends the scope of its user base [11]. In addition, mutual understanding requires confidence in the reliability and high quality of reporting. This aspect is very important, and it is also covered in the scientific literature, such as in the works of Edgley, Jones, & Atkins [12], Trotman & Trotman [13].

Some scientific papers examine the content of disclosures about specific issues of corporate social responsibility (Fernandez-Feijoo, Romero, & Ruiz [14]; Gamerschlag, Moller, & Verbeeten [15]; Hassan, & Ibrahim [16]). However, such studies provide only the basis for a more serious analysis of further improvement in the reporting standards of corporate social responsibility. For example, the willingness of investors to develop the reporting of corporate social responsibility information is analyzed in the works of Qiu, Shaukat, & Tharyan [17], Marsat, & Williams [18]. An in-depth scientific analysis of conceptual and methodological issues in environmental accounting based on more than 80 scientific sources was conducted by Rishar & Altukhova [19]. They came to the conclusion of the need to reform corporate law and accounting practices. The authors proposed the CARE model, which transposes the accounting model of traditional capitalism to natural and human capital. They concluded that this model could be seen as "a vehicle for true capitalism" and suggested establishing "a new environmental accounting law that would ratify a new vision of the concepts of capital and profit for environmental and social governance" [19].

2 DATA AND METHODS

The paper used data from Russian corporate reports, and the methods of analysis, synthesis, grouping and comparison were applied to provide an overview and systematization of various scientific views about corporate social responsibility as the subject matter of accounting science. The paper was prepared by using such scientific methods as analysis, synthesis, generalization, abstraction, historical and logical methods, comparison, and chronological method. To assess the need and feasibility of corporate social and environmental reporting by Russian economic entities, the authors conducted a survey of employees in financial and accounting functions. The survey involved 169 people working in medium-sized companies. The companies of respondents included both Russian and foreign organizations.

3 RESULTS

One of the key sources for building a reliable and high-quality information space in the economy is the reporting of its business entities. Reporting is usually divided into several types, such as financial reporting, tax reporting, management reporting, as well as other types of reporting, including non-financial information. The summary reports on social and environmental responsibility have been replaced by integrated reporting, which shows how the company's value is created as a result of interactions between the organization's strategy, corporate governance, performance, prospects and the external world [20].

The term "corporate reporting" is commonly used to refer to a unified report that brings together all types of the reports listed above. This reporting must be of high quality, i.e. it should be reliable, transparent and available to all users. As with any other reporting, its content and structure depend on the requirements and expectations of its users. Therefore, the question of who is using such reporting is very important. The state and development prospects of reporting depend on the nature of users, their impact on the economy, politics, and technological progress. Moreover, in certain conditions, the influence of users is due to their number and share in the global population.

The content and qualitative parameters of reporting; its actual submission by economic entities; the fate of such reporting, its significance, duration, the scale of the sphere covered by its impact, and its value for those who generated it depend on the ability of users to influence and their activity in solving national and international issues. The issue of those who use the information of corporate social responsibility can no longer be addressed as easily as the issue of those who use the information of financial, management and tax reporting, when the range of the most interested users is well-known, and their information requests, albeit changing, continue overall in the same manner.

First, it should be noted that reporting on social and environmental challenges is of interest not only to individual groups of users, but to humanity as a whole, since the social and environmental issues affect everyone living on the planet directly, rather than in an indirect way as in the case of financial

results. In this case, the number of potential users is not commensurate with the number of those who use financial, tax and management reporting information. Although the influence of an individual who is not a major investor, businessperson, politician or bureaucrat is small, the mere number of such individuals already creates a new quality. At the same time, new technologies for the dissemination and processing of information, and digitization also have an impact on the increase in the number of users and their awareness of both environmental and social problems, as well as the availability of corporate reports. An important role is also played by the ability of users, state and non-state regulators of corporate accounting and reporting to influence the economic entities with regard to the requirement for submitting the reports on their corporate social responsibility. In addition to answering the natural question of whether the users find such reporting satisfactory, credible and meeting their expectations, studying these users would make it possible to address the following issues:

- the speed and means of communicating/receiving the reporting information to/by the users
- the emergence of a certain worldview among the users under the impact of this information
- the possibility of increasing/defusing social tensions among the users (by indicating the facts)
- the desired means of visualizing this information in line with the level of digital technology
- the ability and interest of users to become active participants in generating such reports by preparing general recommendations for such reporting and recommendations for specific companies, along with the indication of important missed information, a lack of knowledge or disregard of material facts on the violation of social or environmental responsibility, etc., i.e. the interest of users in getting feedback from reporting entities and the authorities responsible for developing the reporting standards
- interest in volunteering in the practical environmental activities of specific economic entities by helping them to implement their environmental policies, programs and projects.

Other approaches to classifying the users of corporate social reporting information are emerging in the context of digitization and real environmental disasters.

Undoubtedly, it is still important to divide the users of such reporting information into internal and external users, but a key characteristic for classifying the internal users is their mastery of business intelligence tools and information technology, which reflects the digitization of the accounting sphere. Moreover, such skills become necessary both for accountants, all managers and, preferably, for all employees [21]. This characteristic is valuable in the context of the manner in which and how quickly the reporting information of economic entities can be communicated to virtually everyone in the world. For internal users, it would be advisable to use a characteristic that allows for dividing them into those who, due to their activities, should have information on corporate social responsibility in the entire company and/or in terms of its individual components and recognize their contribution and their and its own responsibility for achieving various social and environmental indicators. Information on the knowledge of relations with related parties and other external organizations (competitors, partners, regulators, public organizations, society) the collaboration with which determines both the global goals and objectives of the company and its individual particular indicators is also valuable for internal users.

Thus far, the most important division of external users is based on their economic essence, but, in the context of globalization, it would be advisable to divide them into international stakeholders and national stakeholders, as well as to divide them by the nature of their interest in the corporate reporting information. Table 1 presents several classifications to describe the users of corporate social reporting information that would be appropriate for further study.

Table 1. Classifications of users of corporate social reporting information.

<table>
<tr><th>Users and their groups</th><th colspan="4">Characteristics of classification, classification groups</th></tr>
<tr><td colspan="5">Internal</td></tr>
<tr><td rowspan="5">IT specialists preparing data and information for all tasks addressed by corporate reporting</td><td colspan="4">Characteristic: mastery of digital computer technology</td></tr>
<tr><td>Digital technology specialists</td><td>Accounting specialists</td><td>Specialists both in digital technology and accounting</td><td>Information collection and processing</td></tr>
<tr><td colspan="4">Characteristic: nature of activity</td></tr>
<tr><td>Assistant</td><td colspan="2">Independent specialist</td><td>Team leader</td></tr>
<tr><td>Specialists</td><td colspan="4">Characteristic: object of responsibility</td></tr>
</table>

<table>
<tr><td>creating specialized applications to provide the information support of their business entities and processes</td><td colspan="3">Business processes</td><td>Business entities</td><td>Business models</td><td colspan="2">Companies</td></tr>
<tr><td></td><td colspan="7">Characteristic: information product used</td></tr>
<tr><td>Business users who do not create the information product on their own but use it</td><td colspan="3">Ready-made standard products (e.g., applications)</td><td colspan="2">Ready-made standard applications along with necessary and easy-to-use tools (e.g., MS Excel tables)</td><td>Specifically requested applications based on practical use, objectives, goals, and strategy</td></tr>
<tr><td colspan="8">External</td></tr>
<tr><td rowspan="8">Users with different interests established by their goals</td><td colspan="7">Characteristic: nature of user</td></tr>
<tr><td>investors</td><td>clients</td><td>partners</td><td>supervisory authorities</td><td>Tax authorities</td><td>Society as a whole and its socio-political groups</td><td>Social organizations (environmental, charitable)</td></tr>
<tr><td colspan="7">Characteristic: approach to obtaining the necessary information</td></tr>
<tr><td colspan="4">Independently reviewing the reporting information by using digital technology, including artificial intelligence</td><td colspan="3">Turning to the analysts</td></tr>
<tr><td colspan="7">Characteristic: mediated participation in generating the reports</td></tr>
<tr><td colspan="4">Active participant</td><td colspan="3">Passive participant</td></tr>
<tr><td colspan="7">Characteristic: practical experience of using the reporting information to address social and environmental challenges</td></tr>
<tr><td colspan="3">Successful experience in addressing the problems</td><td colspan="2">Negative experience in addressing the problems</td><td colspan="2">Lack of experience</td></tr>
<tr><td rowspan="2">Users at different levels of globalization</td><td colspan="7">Characteristic: using reporting information of economic entities (problem solvers) at different levels of globalization for decision making</td></tr>
<tr><td colspan="3">International (foreign)</td><td colspan="2">Union of states</td><td colspan="2">National</td></tr>
</table>

Source: Prepared by the authors

Recently, many companies have been paying considerable attention to the environmental component in their corporate reporting. Corporateregister.com, a specialized database, includes more than 100 thousand reports on more than 17 thousand companies in the world (as of April 2019). But not all economic entities prepare exactly this kind of corporate reporting. Typically, what companies call corporate reporting is just a set of reports that are either poorly related or not related at all. Many medium-sized companies simply ignore non-financial reports, even when preparing IFRS financial statements. At the same time, even despite all the costs of preparing such reports, they also have an undeniable advantage over financial reporting [22]. To meet the interests of all people in the world, the corporate accounting used as the basis to generate corporate social reporting should continue to increase its multi-dimensionality, flexibility, be multipurpose and easily designed in any specified direction; and it should be primarily aimed at providing users with the ability to make forecasts. All this can be achieved through the use of Business intelligence technology, blockchain technology and other digital technologies. So far, the requirements of users have been in conflict with the results of corporate social reporting. For example, only about 50% of companies with an environmentally

oriented business model have increased their profits [23]. However, our study obtained the following results (Table 2).

Table 2. Results of a survey of employees in financial and accounting functions of mid-sized companies on the need and ability to generate corporate social reporting

Statements that had to be either accepted, rejected or ignored	**Share of respondents who answered "yes" and work in companies, %**	
	that prepare environmental and social reports	**that do not prepare any environmental and social reports**
Information is useful for the reporting company	59	32
Information from other companies is useful for you personally	93	84
In the next 2–3 years, your company plans to make non-mandatory social and environmental disclosures	91	26
Preparing the reports is too complex for the company and will add many responsibilities for me personally	7	88
I am concerned about environmental and social issues	98	92

Source: Prepared by the authors

Table 2 shows that all respondents in the survey understand the importance of such reporting and would like to receive such information from all other companies. At the same time, there are concerns that preparing such reports on their job will be too onerous. However, the companies that already generate such reports have clearly learned how to do so at a lower cost and see it as providing more benefits than creating problems. Such a survey demands further continuation and a more in-depth study of the nature of users and their information needs. However, it shows that there are prospects for developing and expanding corporate social responsibility reporting, and there is a need for more active users.

4 CONCLUSION

Globalization and digitization lead to unlimited growth of users of corporate social and environmental reporting information. Further study of users of corporate social and environmental reporting will make it possible to identify not only the shortcomings of existing reporting, but also the expectations of users, and will even allow for predicting them. This is necessary both for the developers of standards for such reporting and for the economic entities, which are enabled by all standards to report additional information, acquire feedback from the users, nurture the quality of their reporting and build trust in it among the users. Such reporting requires a high level of interactivity, care for its communication to users, convenience of using, and the expansion of the reporting area by extending it to comparative information on the industry and competitors along with the relevant links. It would be also useful to provide social advertising of such reporting and promote it like a healthy lifestyle.

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Circular Economy as an Answer to the Global Development Challenges

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Abstract

The Circular Economy is today one of the most important theoretical interdisciplinary concepts which is increasingly shaped into a coherent purposeful whole. The concept, as a "focal point," draws attention and at the same time impact a whole range of theoretical, methodological and applicative disciplines, intellectual movements and practical techniques, developed over the past decades as an attempt to respond to some of the greatest global challenges of the modern world: devastation of natural resources, uncontrolled accumulation of discarded remnants of these resources after their exploitation and return to the system as (often very toxic) waste, disturbance of ecosystem balances and endangering the environment in the widest sense. The paper points to some of these concepts whose contributions in this domain have attracted the greatest attention of the scientific and professional public, such as “Cradle to Cradle", Performance Economics (also known as Functional Service Economics), Biomimicry, Industrial Ecology, Natural Capitalism and Blue Economy.

Keywords: Circular Flow of Materials and Energy, Sustainable Development, Environment, Industrial and Social Systems, Zero Waste Models

1 INTRODUCTION

Modern economies, as well as societies, are strongly marked by globalization, a phenomenon that dramatically increases and accelerates the flows of capital, people, goods and information at the planet level. Like all developmental phenomena in history, globalization is also followed by numerous controversies and contradictions: it is a factor of the unprecedented development of economies and societies, of the growth of general welfare and living standards at the planetary level, but at the same time it is a factor and cause of problems and difficulties because of its comprehensiveness and all-encompassing presence in virtually all domains of the functioning of modern societies [16]. Because of this in some cases it begins to pose a risk for humans and the planet. Forms of development based on traditional technologies which in the framework of globalization get the characteristics of the omnipresent phenomenon, become the cause of climate change, devastation of natural (especially energy) resources, pollution of the environment and dramatic disturbance of the balance in ecosystems. These changes today are taking place on a global scale and going on with such dramatic intensity that makes them a threat which requires a quick, decisive and radical response that will be as comprehensive as the problems that it is trying to answer to. Today, in the current conditions of the modern industrial environment at the global level, the concept of the Circular Economy is one of the most important attempts to create a completely new, innovative approach to economic (and overall social) development [5]).

The authors of the concept introduce a completely new perspective on how to create technological processes and products, in which resources and sources of energy needed, instead of being consumed and permanently wasted and lost, are constantly regenerating and renewing. The basis of the successful development of this process is creativity and innovation that become its immanent characteristics and features.

2 THE MODEL OF CIRCULAR ECONOMY

The Circular Economy is focusing on benefits that relate to society as a whole and thereby attempts to overcome the limitations of current models based on the extraction and definitive consumption of natural resources that leave behind a devastated and contaminated natural environment. In this new innovative approach to economic activity, the unlimited and uncontrolled consumption of natural resources which is part of the creation of waste materials and pollution - is gradually abandoned. The

circular model relies on renewable energy sources and in this context, it builds economic, natural and social capitals.

The Circular Economy is based on the three following key principles:

- Reducing or even eliminating waste and pollution from the system
- Continuously holding of products and materials in function
- Restoring and conserving natural systems

The essential characteristic of the model is its universality and applicability at all levels of functioning: local, regional and global. It is important for large, but also for small businesses. It is applicable in the functioning of organizations, but also in the lives of individuals. The concept of a Circular Economy can be understood as a system that, on a long-term basis, creates an economic and business framework for development and creates benefits for the economy, society, and the living environment in the widest sense.

The Circular Economy model is based on the cyclical movement of materials and energy in closed systems. There are two basic generic types of cyclical movement: technical and biological. Biological cycles are "projected" so that materials (food, biological materials, such as wood, agricultural products, etc.) are returned to the system after their use through processes such as composting, anaerobic digestion, etc. Through these cycles, living systems are restored, such as soil, flora and fauna, whereby the sources of energy and resources are constantly renewed, thus ensuring the continuously sustainable functioning of the economy and society. Technical cycles do not have these characteristics at a priori level, but they can be designed so that products, components, and materials are regenerated and renewed through strategies such as their reuse/multiuse, repairing, processing and, ultimately, recycling.

3 THEORETICAL BASIS OF THE CIRCULAR ECONOMY

The notion of a Circular Economy, or rather a circularity as a phenomena in society and nature, is not new - on the contrary, it is spoken of even in ancient times in a more or less direct way, and many of its related ideas can be found in some of the most important antiquity schools of philosophy. After the Second World War, in the most developed industrial countries, this idea again gained considerable attention especially in the study of non-linear systems within the framework of developm1ent of the first computers. This practice has pointed to the complex, interconnected and therefore unpredictable nature of the world in which we are living. Processes that take place in this world are much more similar to biological processes (e.g. metabolism) than to the processes of operation of mechanical devices and machines. It seems that in the modern times, the development of digital technology development will even accelerate transition from a traditional to a Circular Economy through a dramatic increase in phenomena such as virtualization and dematerialization of economies and social phenomena and development of the artificial intelligence based on feedbacks. The concept of Circular Economy as one of the most important contemporary theories of the functioning and development of modern economies and societies is the result of the work of numerous authors from different theoretical disciplines, both technical and humanistic, as well as engineering, who have contributed to its development for the last several decades. However, its practical application in modern economic systems and industrial processes has received a special momentum in the late seventies of the last century. An important role was played by a group of theoreticians, businesspeople and other public figures, which is relatively small, but proved to be very influential. Today, the concept of Circular Economy represents the synthesis of several very important theories about the functioning of the economy and society. It includes the following theoretical schools of thoughts: the philosophy of design known as Cradle to Cradle; a Functional Service Economy, known also as Performance Economy; Biomimicry; Industrial Ecology; Natural Capitalism; Blue Economy and Regenerative Design and other. The concept of a Circular Economy is considered a “point of meeting” all these (and related concepts) and theories. It encounters and intertwines their most important theoretical and methodological approaches, which in a synergistic way contributes to the formation of a very respectable corpus of knowledge, methods and techniques, which ultimately could lead to a relevant answer to some of the most important issues and challenges of the contemporary world economies and societies, such as: climate change issues, global pollution, uncontrolled spending and permanent devastation of resources and energy, etc. Hereinafter, the crucial elements for each of these concepts, their mutual relations and connections and particularly their impact on developing of the concept of Circular Economy, are presented.

3.1 Cradle to Cradle Design Concept

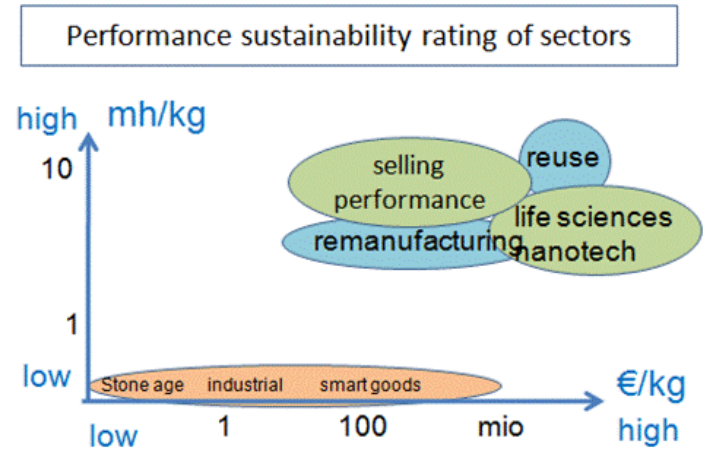
Concept known by the name Cradle to Cradle or C2C is based on the approach of creating technical, as well as social systems, which seeks for an inspiration in the processes that happen in nature. In that aspect, it is about the so-called biomimetic approach1 whose direct role model is the metabolic process specific for living organisms where different substances (such as food) are introduced to the process; they are processed in a healthy and secure manner, than they are thrown out of the system and returned to the nature where they once again, through different processes (for example, different types of agricultural processing), appear in different material forms (agricultural products and the food produced based on it). The process continues by introducing these materials (agricultural products) once again to the metabolic process and the entire circle is renewed again. It is about a circle flow that renewed continually in an unhindered manner and that, therefore, has no negative side-effects. In this process, there is no creation of polluting waste materials, harmful for the nature from which they are coming from. The term itself (from Cradle to Cradle) was created from a popular corporative phrase from Cradle to Grave. The process starts by birth, but unlike the standard process, it does not end with the death, i.e. „grave", but it is renewed (it is „born" once again and returned to the „cradle") and that is how it functions as a continuous self(sustainable) process. This implicates that the model is sustainable and secure in the aspect of the future life and future generations. It is a holistic concept that was firstly developed as a model applicable within technical systems, but it was soon extended to wider economic, and the widest social systems. Within industrial production systems, this approach stresses the need of achieving harmony with the natural systems, so they are not endangering them by pilling up of the waste, pollution, impairment of balance in the ecosystem, etc. Moreover, if possible, these processes should protect and enrich natural processes through the balanced and sustainable „technical metabolism ". Very quickly, the concept has found its application in numerous social-economic systems, such as functioning of complex urban systems, construction and running of different building complexes, and other.

The syntagma Cradle to Cradle was firstly launched by Swedish architect Walter R. Stahel in the 1970's [18], but the very concept was further developed by German chemist Michael Braungart and American architect Bill McDonough [3]. The term „Cradle to Cradle„ is today a protected trademark of the consultant company McDonough Braungart Design Chemistri (MBDC). Concept, therefore, starts from the standpoint that all the materials included in industrial (and generally, economic and social) processes are metabolic „raw materials for processing ", i.e. the „nutrients". Although nutrients in biological processes are different from the inputs that are used in technical-technological processes, the principle that both processes follow, are not different. In both cases, these substances enter the process, they get processed, and as the result we have final output. What is important for the concept C2C is that the process (biological, technical and social) is structured in such a manner that the negative effects on the environment are either reduced or eliminated after its ending. The creators of technical systems within the concept from Cradle to Cradle are trying to observe the processes of a natural „biological metabolism "as a model for the development of technical „metabolic" systems within which the flow of industrial materials takes place. They try to devise the components of products in such a manner that they could be continuously renewed and reused as it is the case with the process of biological metabolism. In these systems there practically are no waste and harmful materials; on the contrary, once used inputs that have passed through the processing are again returned as renewed, recycled resources. This, however, implies that along with manufacturing processes, simultaneously the systems for collection and recycling are established. Inputs in the above-mentioned aspect can be included in one of the two categories: technical or biological one. Technical inputs can be considered as materials (nutrients) which „feed" technical processes and commonly refer to synthetic materials. What make a difference between these „nutrients" and synthetic materials used in standard technical processes is that they are non-toxic and therefore harmless for the natural environment. Instead of being disposed of after being used as a waste, they can relatively simply be recycled and therefore they have multiple usages within continuous production cycles.

[1]Biomimetics is the name for a combination of scientific disciplines of biology, chemistry, mathematics and physics aiming at the study of structures and functions of biological systems. The knowledge obtained in this manner is supposed to be used as a model for development of different technical and social systems.

3.2 Economy of Performances

Previously mentioned Swedish architect, Walter Stahel, after creating the expression Cradle to Cradle in the end of 1970's, continued his work on development of concepts of the so-called closed loop in technical manufacturing processes. Moreover, he founded Product-Life Institute in Geneva whose main four goals were: extension of products' life span, creation of long-term goods, regeneration of activities and waste prevention.



Stahel, Walter (2010) The Performance Economy, Palgrave

In the year 1976. Stahel prepared a special report entitled The Potential for Substituting Manpower for Energy which was ordered by European Commission [18]. In this report, Stahel has expressed his vision of economy that moves in circles (Circular Economy) and described its possible impacts on the creation of new jobs, economic competitiveness, saving of resources and prevention of waste creation.

One of the important aspects that he particularly insisted on was the creation of economy with much more stress on services than products. He called this approach „functional economy of services“ which was later developed in the term Performance Economy [19]. According to Stahel, Circular Economy is a general generic framework for the definition of basic principles that are common for several theoretical approaches and concepts. In his works Stahel also explains how businesses and governments, owing to technological progress and application of innovative and creative approaches, don't have to accomplish their goals in the market at the expense of the environment or waste resources unnecessarily. On the contrary, with the application of high performance economy which is based on „smart“ high technological solutions, they can achieve significant benefits for themselves and simultaneously contribute to the environmental protection. The benefits that can be expected from such an approach, among others, are the following:

- Introduction of the models based on highly technological solutions improves the performances of economic processes and simultaneously creates much more workplaces and higher value added
- By the development of services related to the usage and sale of products, their performances are increased, in a longer time period
- By introducing innovative solutions in traditional sectors, resources are used in a more efficient manner and simultaneously, both manual and highly qualified jobs are created which affects the reduction of overall unemployment; energy is more efficiently used, and less waste is generated
- Introduction of new technological methods helps establishing socially more acceptable relation between engaged labor and used resources.

3.3 Biomimicry

The concept of Biomimicry is based on attempts to mimic natural forms, processes and ecosystems when designing industrial processes, in order to achieve the circular design of the product as the goal. The basic idea is that Nature has already solved many of the problems that man faces today: energy conservation, food production, climate control, harmless chemistry, efficient transport, cooperation between process actors and much more. To create a sustainable economy, one does not have to start from "zero" - it is enough to carefully observe the Nature [2]. Thus, studying an ordinary leaf of a plant can result in a significant improvement of solar cells; studying the formation and functioning of coral reefs can initiate the creation of the idea of developing a more sustainable company, etc. Innovation with the application of a biomedical methodology usually begins with one simple, but crucial question: "What the Nature would do in our place?" Such an approach can result in the creation of an individual innovative solution and a new idea, but also in a complete reversal of the given context by applying processes that are in the natural environment already confirmed as safe for present and future generations. In this process, we have three forms or levels of biomimicry whose application can initiate innovations at the most diverse points in the system [2]:

- The first level of biomimicry is the imitation of the natural forms - For example, imitation of owl's feathers in order to create a fabric that opens anywhere along its surface. Copying the design of feathers is only the beginning that can lead to the solution, which is applicable not only at some points, but for the system.
- The second level of biomimicry imitates natural process, i.e. imitates the manner of making natural materials - Owl's feathers are assembled autonomously at the body temperature without any toxins or high pressures, through natural chemistry (so-called Green Chemistry tries to imitate these recipes of the nature).
- At the third level there is the imitation of natural ecosystems - Owl's feather is a part of a complex system: it is a part of owl's organism which is a part of the forest, which is a part of biome, which is a part of sustainable biosphere. Like this, fabric inspired by owl must be a part of a bigger economy which works on renovation, rather than exhaustion of the Earth and its resources. However, we must bear in mind the so-called "wider perspective": namely, if only the fabric production is inspired by Green Chemistry technology and the workers vow in workshops with non-efficient technological processes, put it on the lorries that pollute the environment and distribute it in an inefficient manner – the final goal of sustainable systems development will once again remain unaccomplished. It is necessary, therefore, to apply the innovative, biomimicry methods along the whole process and thus enable the sustainability of the system (not only its individual subsystems).

Imitation of the natural system requires that when designing a product, attention is not focused solely on the product as such, but it is necessary to pay the same attention to its integration into the system. This may involve assessing its ability to meet consumer needs, its aesthetic aspect, integration into the systems of industrial chains, its convenience for transportation, possible forms of sales, and at the end its regeneration in the way that it does, for example, a forest as part of a wider natural system. If it is possible to imitate nature on all three levels (the level of the natural form, the natural process, and the natural system), then everything that all well-adapted organisms do will be achieved: to create conditions suitable for life. Creating conditions suitable for life is not optional, but it is necessary for all organisms that manage to fit in for a long period of evolution. In order to preserve the earth as a home of mankind, people will have to learn from their predecessors how to filter the air, clean water, restore land, i.e. how to keep the habitat lush and sustainable. Janine Benyus, one of the promoters of this approach and the author of the book Biomimicry: Innovation Inspired by Nature, defines the new approach as "a discipline that studies the best ideas of nature, and then imitates these designs and processes for solving human problems" [2]. Studying of the leaf in order to make a better solar cell is one of the examples. She observes that as an "innovation inspired by nature". According to this author, biomimicry relies on three crucial approaches:

- Observing the Nature as a model that people can and should imitate by studying their natural systems, way processes within them take place and then by their imitation we can reach the solutions of human problems
- Using natural resources as standards for measurement: sustainable technical innovation processes can be evaluated based on their contribution to ecological solutions

- Observing the Nature as mentor: relationship with Nature should be such that we learn from it and take its solutions that have passed multiple evolution verifications and applied them in solving the problems of contemporary humanity, instead of taking and devastating resources from it.

3.4 Industrial Ecology

The discipline Industrial ecology deals with the study of the way within production industrial systems we establish the flows of material and energy. The goal is for those flows to be shaped like closed processes where the inputs are processed into final outputs so that waste creation is reduced to the least possible measure and the waste which is created anyway is recycled and taken back as a regenerated input in the next production cycle. During projecting of production-technical processes, Industrial ecology takes into consideration the ecological constraints and, simultaneously, their global impact. The guiding idea of this approach is for the processes to be shaped in such a manner to function in a way that is like the functioning of living biological systems. Having in mind the inter-disciplinarily of this approach, it is sometimes defining as “science on sustainability”, which stresses the preservation and regeneration of natural capital, as well as sustainability of social welfare [15]. Industrial ecology as a concept is presented to both scientific and professional public by the article of the authors Robert Frosch and Nicholas E. Gallopoulos, published in the magazine Scientific American in 1989 [6]. Their idea was that the industrial systems should be designed looking up to ecosystems, where the materials that represent waste in one process, become the resources in the other. Outputs of one industry should be the inputs of another, which reduces the consumption of raw materials, preserves the environment and the issue of waste is solved in a more efficient and cheaper manner. Good example for such a practice is the industrial park in the city of Kalundborg in Denmark, which is projected in such a manner that there are established numerous and diverse connections between the processes of different sections and subjects that function within the park. The system functions in a manner that by-products and waste heats are exchanged between the power plant, oil refinery, pharmaceutical factory, gypsum boards factory, enzyme manufacturers, public utility company that treats waste and local self-government.

Industrial ecology is a discipline that covers different fields, from technical and engineering disciplines, natural sciences, to the economy and general social sciences. It can be defined as “multidisciplinary discourse based on systems that strive to the understanding of the emergence of complex integrated social and natural systems” [6]. Ambition of the authors of this approach is to study processes in nature and identify basic principles according to which they take place and then to try to apply them in technical and social systems by the method of analogy. Similarly, to natural processes, newly-projected technical-industrial and social systems based on this approach become the models with the so-called “closed loops” where there is no waste and no undesired effects for the environment. Studies within the discipline of Industrial ecology particularly deal with the following issues:

- Studies of material and energy flows (so-called "industrial metabolism")
- Dematerialization and decarbonization of industrial processes
- Relationship and impacts of technological changes on the environment
- Planning and projecting life span of the products
- Projection of the systems in accordance with the environment (so-called “eco-design”)
- Development of eco-industrial parks (so-called “industrial symbiosis”)
- Ecological policy oriented on products development
- Development of ecologically efficient systems

Having in mind general goals of Industrial ecology, related to the energy and material preservation, its efforts to redefine market relations so that the stress is transferred from products to services, development of the Industrial ecology can be observed as one of the goals of the Natural Capitalism.

3.5 Natural Capitalism

Concept of Natural Capitalism observes contemporary economy as a global system where the interests of business and natural environment meet and respect each other [14]. The business

operations are based on both types of capitals: one which was created as a result of people's activity and other which is result of the Nature. Natural capital is defined as global supplies of natural goods, including land, air, water and all living beings. The concept of Natural Capitalism was developed and promoted by Hawken, Amory Lovins and Hunter Lovins [9]. Their most significant recommendations for redefining contemporary forms of the functioning of industrial and social systems can be summarized as follows:

- Natural resources should be used in a productive and efficient manner - Through innovative changes in designing of the products, manufacturing processes and application of advanced technologies, natural resources can last much longer, they can be renewed all the time, unlike the common practice today where they are devastated and permanently destroyed.
- Designing of the processes and products in line with Nature and trying to imitate it as much as possible – in this domain Natural capitalism, similar to Industrial ecology, tends to eliminate waste in processes through developing the closed loop systems where the inputs move in cycles, entering the processes and returning to the environment in a harmless manner through recycling.
- Gradually switch to the Services and Flows business model – in this approach, the stress is transferred from manufacturing and consuming products and goods to the value creation through a continuous flow of services which harmonizes the interests of sellers and buyers and simultaneously, the resources are used in a more productive manner.
- Reinvest in natural capital – natural capital is not unlimited and indestructible, so its uncontrolled usage can bring to danger its renovation and the maintenance of natural systems. In the system of Natural Capitalism, it is, therefore, implied that those who are using natural capital, i.e. natural resources in order to achieve their business goals, should invest in its renovation and regeneration.
- Advocates of the concept Natural Capitalism criticize traditional concept of industrial capitalism. Unlike the last one that puts the stress on financial capital and its unlimited extension and reproduction, Natural Capitalism in its calculation of values includes natural resources and living systems, as well as social and cultural systems that are the basis of capital created by the people.[2]

This approach tries to ask the question on how the contemporary economies would look like if we would equally evaluate all capital forms – not only industrial, but also natural ones and how would economy look like if it would not function exclusively according to abstract principles of neoclassical economy and corporative accounting, but also of the nature. It advocates for the application of standard accounting principles, both on financial and natural and human capital. In that manner, natural resources would not be any more treated as free available inexhaustible goods, but on the contrary, as limited and therefore valuable factors of production. According to the authors, such options are realistic and possible. Moreover, choosing them could "offer an astonishing new set of possibilities for entire society, nothing less than the very next industrial revolution [9]. In the system of traditional industrial capitalism, capital appears only in the form of money and goods. Natural Capitalism, however, extends this perspective and includes both natural and human capital in the capital. In this new perspective, the issues such as pollution, social injustice, etc., become the general issues of economic and social system functioning, rather than exclusively the issues of capitalism as a system of financial profit generation. In that aspect, the assumptions that Natural Capitalism is based on, are the following:

- Development of global economy in the future is directly dependent on the level of availability and functionality of the natural capital, particularly on the resources that are irreplaceable and for which we cannot, therefore, determine their commercial, market value

[2]In an interview from the year 2009., Paul Hawken looked back on the term "natural capitalism" which is the name of this concept and discipline. He mentioned that the intention for the title was to be the reference to the expression *natural capital*, which was firstly made by E. F. Schumacher in 1973. Hawken has supported the basic concept of natural capital and its implication for the society and added to the word "capital" the suffix "-ism" in order to emphasis that industrial systems need to include and valued in their operations the phenomena related to the nature. According to Hawken, although they support the spirit of trade and entrepreneurship, authors of the concept do not support the "pathological" characteristics of "pure capitalism".

- Main causes of the devastation of natural capital lie in business systems that function according to the principles of classical capitalism and wasteful forms of consumption that are related to it. These problems require the undertaking of economic and social policy proactive measures in order to reverse the mentioned unfavourable trends
- Sustainable economic development can be achieved within free market system, but the one within which all capital forms are completely evaluated, including the one created by the people, as well as natural capital
- Benefits of economic development cannot be measured only by indicators of quantitative growth (continuous, uncontrolled growth of production, sale, profits) but primarily by the increase of the level of services quality
- Establishing sustainable economies and, in a wider aspect, social and natural systems, cannot be achieved if we firstly do not correct the excessive global inequalities in the distribution of incomes and material goods.

3.6 Blue Economy

The concept of Blue Economy is related to the Belgium businessman Gunter Pauli, who has prepared the Report in 2010 under this title for the Roman Club [13]. In this Report, he has listed a series of specific case studies, i.e. practices that he had labelled as Blue Economy. Blue Economy is, to a less extent, observed as a separate comprehensive theoretical discipline, but more as a way of thinking and an intellectual movement that is specific for the openness and readiness to include similar ideas, concepts and methods. Blue Economy is described as a system where the "resources are used in cascade systems in which the waste from one product, becomes the input for the creation of the new cash flow" (Gunter P., 2010). In the Report mentioned, the specific cases are described as "100 innovations that can create 100 million workplaces in the next 10 years". According to the concept, the final goal of the business model of Blue Economy is the transformation of society of scarcity to the society of abundance, in such a manner to solve the issues that cause ecological problems as well as the social problems that result from them, by the application of innovative and creative processes. Blue Economy particularly advocates for the usage of innovative, scientific approaches that have the characteristics of the so-called open source, i.e. which are open and available to everyone, in solving crucial issues of economy, looking up to the processes common for the natural world. The aim of this approach is to find solutions that are ecologically useful and that simultaneously bring financial and wider social benefits. It is suggested to change the way industrial processes are led by re-directing the processes in which rare and high energy inputs are used, to the solutions that are based on simple and pure technologies. In addition, it is suggested for the focus to be transferred from costs reduction to the creation of new added values.

4 CONCLUSION

The Circular Economy is one of the most important and most relevant attempts to answer the problems of today global development. Its significance is especially emphasized by the fact that it is a concept around which several theoretical approaches and intellectual movements have been grouped in the last few decades, slowly creating a relatively coherent body of knowledge, theoretical hypotheses, methodologies, as well as practical, concrete solutions (technological procedures, innovation and policy) focused on solving these problems. All of these concepts are focused on new technologies, on innovative and creative solutions that try to transform the straight-line, one-way flow of development that leads to devastation of resources and nature as a whole, into the circular one, and so to return it into the equilibrium and harmony in which the welfare of subjects at all levels will be realized. In such a revolutionary development framework, the benefits of states and corporations will be aligned with the benefits of local communities and individuals; economic development will not endanger, but will support the development of other social areas, and ultimately all these flows and processes will be in harmony with the natural environment (earth, water, air and all living beings on the planet Earth).

Finally, it can be concluded that all these concepts that are intertwining and meeting in the theory of Circular Economy, have almost identical goal: finding a way to reverse the effects of classical models economy and the society development, characterized by linear growth based on the principles of Take-Make-Spent-Throw. In these models, resources are viewed as always accessible, unlimited and

available so it's only focus is to extract them in enough quantities, to generate ever-increasing quantities of goods that can be sold in order to achieve as much profit as possible. The resources that remain unused during processing are simply dumped, i.e. treated as unnecessary by-product - waste, which is in uncontrolled way throwing so that at one moment inevitably disturbs the balances in the environment. Contrary to this approach, the Circular Economy requires innovative, creative models of development that are sustainable, clean, non-toxic and in line with the natural environment in the broadest sense (with land, water, air and all living beings).

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Problems of Increase in Tourism Global Competitiveness of Russia

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Abstract

In article aspects of the organization of tourism in the countries of the world are disclosed, the general contribution of income from tourism to GDP of the country is shown. Travel business as a diversified system is described, data of the Travel and Tourism Competitiveness Index (TTCI) are provided. Several problems of development of the Russian tourism is listed.

Keywords: travel business, global competitiveness, tourism revenues, Travel and Tourism Competitiveness Index

1 INTRODUCTION

It is difficult to diminish a tourism role in world economy, so, the level of the tourist sector in world economy is comparable to the oil industry. In recent years it exceeded 35%. The annual rate of gain of the capital involved in travel business is more than 30%. For 2017 over 7% of the world capital are invested in tourism industry. Considering the involvement into travel business of a set of the branches of the national economy about 140 million population of Earth are engaged in tourism.

For several the countries travel business revenues are the prevailing source of revenues of the state and the share of income from tourism in GDP of these countries exceeds 30%. Over the certain countries this indicator exceeds 50%, for example, Antigua and Barbuda (75.8%), Macau (89.5%), Anguilla (71%), Seishelsky islands (54.5%). In Russia the share of income from tourism makes only 4.8% of GDP that is significantly lower than a similar indicator of the European countries (Spain - 14.9%, Italy - 13.0%, Germany - 10.7%, Great Britain - 10.5%, etc.) and the USA (7.7%).

The United States of America and China are the main leading countries on received income, come to the budget from travel business (in US dollars) for the last five years. Their income for 2017 was 1501.90 and 1349.3 billion US dollars respectively (see table 1). Tourism revenues of Russia are significantly lower and is nearly 20 times less than similar income of the USA.

Table 1. - The general contribution of income from tourism to GDP of the country (in billion US dollars)

Country	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
USA	919.3	1063.8	1113.2	1209.1	1267.9	1300.5	1363.0	1392.3	1446.3	1501.9
China	127.0	226.1	502.7	692.6	300.8	928.5	1048.9	1151.2	1229.3	1349.3
Germany	259.3	333.6	372.2	399.2	375.1	392.7	412.5	362.6	372.9	395.2
Japan	443.3	397.1	395.1	419.7	419.2	355.0	316.2	290.3	331.2	331.2
Great Britain	236.2	232.9	231.7	260.1	279.7	283.2	297.3	290.0	264.9	266.1
Russian Federation	16.7	45.4	37.5	106.7	105.4	109.2	100.3	64.5	61.5	76.1

Sourse: https://knoema.ru

2 METHODOLOGY

Considering travel business as a diversified system which includes a set of the branches of economy having a direct bearing not only to tourism - rendering services in movement of tourists (carriers, travel agencies and tour operators), to accommodation of tourists (hotels, hotels, boarding houses, sanatoria, resorts, etc.), but also the industries, adjacent to tourism, for example, the public authorities

of regulation of tourism and visa organs, the organizations occupied with production and selling of souvenir products, goods for sport, tourism and rest, catering establishment, the entertainment industry, etc. it is visible relevancy of a role of tourism in social and economic development of the country.

The rating on the level of competitiveness of tourism has a great influence on image of the country and its situation in the world. Assessment of the countries of the world in terms of existence and the level of favourable conditions for tourism and travel is carried out by organizers of the World Economic Forum in Davos in the form of "Travel and Tourism Competitiveness Index" (further — TTCI).

When determining TTCI of the country the set of indicators reflecting development of the country and tourist infrastructure is considered, all indicators are united in 4 categories: favorable conditions, human capital, markets and innovative ecosystem.

In total for assessment of the TTCI index 12 generalized indicators are used: institutes, infrastructure, implementation of TTCI, providing, health, skills, market of products, labor market, financial system, amount of the market, dynamism of business activity, innovative potential.

According to the data provided in the Report on global competitiveness in 2018 on all 12 generalized indicators Russia has positive dynamics. For the first time the ratings of the countries published in 2007 by the TTCI of the World Economic Forum were developed considering the industrial program of aircraft, travel and tourism. Experts in the course of the analysis of competitiveness of the countries attracted several the specialized organizations to obtaining the most reliable information, for example, the International Air Transport Association, the International Union of Conservation, World tourist the organization and the World council for travel and tourism, etc. Researches are conducted regularly, and the number of the countries in the list only increases that demonstrates the importance of travel business in world economy. The TTCI assessment technique is constantly improved too and when determining rating of the countries for 2018 the advanced TTCI 4.0 index was applied.

3 RESULTS

Dynamics of ratings of several the countries is presented in table 2. This table reflects constant dynamics of leaders as the TTCI considers changes and incidents in the country.

Table 2. - Rating of the countries in Travel and Tourism Competitiveness Index for years 2011-2018.

Country	Reiting TTCI				
	2011	2013	2015	2017	2018
	139 countries	140 countries	141 countries	136 countries	140 countries
USA	6	6	4	1	1
Singapore	10	10	11	2	2
Germany	2	2	3	3	3
Switzerland	1	1	6	4	4
Japan	22	14	9	8	5
Nederland	14	13	14	5	6
Hong Kong	12	15	13	7	7
Great Britain	7	5	5	6	8
Sweden	5	9	23	9	9
Denmark	16	21	27	11	10
Canada	9	8	10	10	12
France	3	7	2	18	17
Austria	4	3	12	21	22
Spain	8	4	1	25	26
Russia	59	63	45	43	43

The researches show that leadership of several the European countries in world tourist infrastructure gradually decreases and several the developing countries begin to attract more and more tourists. Advantages of Europe and others «old» directions are the conventional sights and well-developed transport network now. However, specialists as the main deterrent of travel business development in Europe mark out difficulties of development and modernization of tourist infrastructure. So, for example, in Great Britain we can see great efforts to increase the power of the airports as Heathrow airport functions for 98% of its capacity. The increase is possible only due to construction of the third runway in this airport. The decision on construction of the third runway was approved by the government at the beginning of June 2018 after more than ten years of a debate.

Germany has same problems with increase in power of tourist infrastructure. The opening of the new airport planned for 2011 Berlin-Brandenburg is transferred from year to year and now its opening is specified by the next period 2020.

Opposite to the European countries China directs considerable investments into development of tourist infrastructure. Start into operation in 2018 of the new terminals of the international airport Beijing Guangzhou and opening in 2019 of the new world's largest airport Daxing in Beijing will allow China to increase its tourist capacity up to 100 million passengers a year.

Assessment of competitiveness of the tourist industry of Russia was carried out constantly and the countries given by the TTCI were present already at the first report of the World Economic Forum.

The index of competitiveness of tourism of Russia from 2007 to 2018 has steady positive dynamics, except for 2013 – when the rating of Russia was downgraded from the 59th place to the 63rd. So in 2007 Russia took the 68th place, in 2009 – the 64th place, in 2011 – the 59th place, in 2015 the rating of Russia significantly grew and the country began to take the 45th place, in 2017-2018 Russia in rating took already the 43rd place.

Experts of Rostourism as the factors which are positively affecting appeal of Russia to travel and tourism mark:

- sanitary and hygienic conditions in the sphere of tourism;

- development of transport infrastructure in the field of the railway and air transportation;

- the cost of services in the sphere of tourism;

- existence of opportunities for cultural and informative and business tourism;

- development of information and communication technologies in tourism.

- development of tourist infrastructure.

In 2018 indicators the efficiency of rail transportation and convenience of the airports took in the rating of the countries the 15 and 18 places respectively. However, the general transport infrastructure of the country has low rating – 51 places from 140 countries. On transport infrastructure the quality of highways (the 104th place) had the most negative impact on the received rating.

Takes strong positions Russia in the rating of development of information and communication technologies in tourism – the 25th place.

In Russia tourism – the developing industry/ It has high potential - the existence of a set of cultural and natural wealth are our advantages. According to the World tourist organization Russia in 2018 occupies only 16th place in the world in the sphere of the international tourism. Such modest situation is explained by several the factors constraining development of travel business in Russia. In the state program approved by the Order of the Government of the Russian Federation in 2012 "Cultural development and tourism" for 2013 - 2020 the following major factors complicating growth of profitability of tourism industry were specified:

1) the visa regime concerning citizens of the foreign states;

2) insufficiency or absence of hotels for tourists and objects of leisure, an unsatisfactory condition of many tourist objects;

3) lack of practice of creation in regions of Russia of favorable conditions for investments into tourist infrastructure;

4) lack of long-term credit tools available to investors with the interest rates allowing to pay back investments into objects of a tourist and recreational complex into terms, acceptable for investors;

5) low quality of service in all sectors of the tourist industry owing to a lack of professional staff;

6) insufficiently active advance of tourism across Russia on world and internal tourist the markets.

According to the Russian experts, in travel business in the nearest future essential positive trends are not expected this result from the fact that the mechanism of regulation of development of travel business and tourist infrastructure not sufficient is worked well out. So the "Development of Internal and Entrance Tourism in the Russian Federation (2011-2018)" program actually was not implemented, even according to official information of Rostourism, on average within implementation of the program only about 4 billion rubles a year were spent and following the results of 2018 only 78% of the means put in the program were mastered.

The chief promotions officer of territories in the AGT Communication agency Vladislav Shulayev as the factors having negative effect on the near-term outlook of development of the tourist sector of economy of Russia marked out two events of 2018:

- non-inclusion of tourism in number of priority national projects, according to May presidential decree N 204;

- transfer of Rostourism to maintaining the Ministry of Economic Development of the Russian Federation that with high probability will cause correction of strategy, inventories of the existing federal programs and projects and also to some experiments in tax and other economic "rules of the game" in the Russian tourism. This fact increasing the level of uncertainty of conducting business in the sphere of tourism will also reduce investment attractiveness of the Russian tourism for private investors.

For the decision of the listed above list of problems of the Russian tourism by the government the Program of development of internal and entrance tourism in the Russian Federation was approved (2019 - 2025). This program is developed results of the federal target program "Development of Internal and Entrance Tourism in the Russian Federation (2011 - 2018)" implemented earlier. Are included in number of priorities of the Program implementation of measures for advance of the Russian tourist product and increase in knowledge of it in the world and internal tourist markets and also stimulation of enterprise and public initiatives via the mechanism of subsidizing and grant support.

4 CONCLUSION

As good points in recent years in development of tourist infrastructure it is possible to allocate growth of competitiveness of the Russian resorts, implementation of reconstruction of highways (for example, across the Golden Ring of Russia), cleaning of the rivers and reservoirs, strengthening of attention to involvement of foreign and Russian tourists to ecological tourism in Russia.

Development of tourism makes the significant contribution to ensuring sustainable social and economic development and social stability of the country as is the catalyst of development small and average forms of business and the microenterprises. Need of the state support of development of tourism is proved also by the fact that increase in number of entrance foreign tourists and reorientation of tourist flows of Russians at internal tourism stimulates development of allied industries of economy. Today tourism forms 3.4% of gross domestic product of the country, influencing 53 allied industries. Creation of one workplace in the sphere of tourism attracts creation to 5 workplaces in allied industries.

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Contemporary Worldwide Energy Policies – An Example of German Energy Transition

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Abstract

The following paper is giving an outlook on the contemporary energy situation in Europe. The nuclear disaster in Japan in 2011 had a bid impact on the global energy policy. Some countries have already changed their energy conception by switching from nuclear energy to renewable energy sources, some countries are on their way of rethinking it. This paper is introducing the Germany's model of energy transition as a pioneer in this field.

Keywords: Nuclear energy, Fukushima, renewable energy, energy transition, innovation, technology, global energy policy, electricity market, energy prices, energy production.

1. CURRENT ENERGY SITUATION

1.1 Fukushima – The nuclear disaster in Japan

On March 11, 2011, in Japan occurred the largest nuclear accident since Chernobyl (1986). One of the strongest earthquakes ever measured in northeastern Japan triggered a tsunami. The earthquake and tsunami collapsed several cooling systems in the Japanese nuclear power plant Fukushima. It came to meltdown in three reactors. Substantial quantities of radioactive material were released. According to Greenpeace, this case was not comparable in its course to the nuclear catastrophe in Chernobyl, where the graphite reactor had been burning for days and thus released a lot of radioactivity into the atmosphere. But the dramatic thing about Fukushima is first, that there were several meltdowns and second, the capital Tokyo is only 250 kilometers away. The population density around Fukushima is 20 times higher than in 1986 in the Chernobyl region. Global mass media described Fukushima as "Japan's darkest day" (SPIEGEL Online)[1], „Japan is facing its greatest crisis since the second world war" (Guardian)[2], "Fukushima: Fallout of fear" (Nature)[3].

1.2 Consequences for the international energy policy

The nuclear disaster in Japan had far-reaching consequences not only for Japan, but also for many other countries. So, decided *Germany* (2011) and *Switzerland* (2011) the nuclear power phase-out. In *China* and in *Japan* can be seen a rethinking in the direction of accelerated energy transition. Many other countries, such as *France*, *Russia*, *US* are continuing to use the nuclear energy. France, the country with the most nuclear power plants in Europe, keeps its nuclear power. Share of nuclear energy in energy production in 2017 in France was approximately 72%. In comparison in Germany it was 11,6 %. *Russia* wants to build a total of 26 nuclear reactors by 2030. In the US there is also no broad debate started on re-evaluating nuclear power.

In the 21st century the world must master a double challenge. On the one hand, the global warming due to high CO2 emissions. A key reason for this is the dependence of modern industrial companies on fossil fuels. On the other hand, finiteness of crude oil, which has enabled the present prosperity. Nuclear energy has been propagated for long period of time as CO2-free, safe and cheap solution to global energy problems. According to the International Energy Agency [2], conventional crude oil production peaked in 2006. These two factors must be regarded by the climate and energy policies of

[1] [SPIEGEL] <https://www.spiegel.de/panorama/gesellschaft/fukushima-katastrophe-japans-dunkelster-tag-a-820581.html)> (09.06.2019)
[2] [The Guardian] <https://www.theguardian.com/world/2011/mar/13/japan-tsunami-earthquake-power-cuts> (09.06.2019)
[3] [Nature] <https://www.nature.com/news/fukushima-fallout-of-fear-1.12194> (09.06.2019)

the future. [1] Such questions as energy security, competitiveness, climate change mitigation as the energy transition is progressing. For this purpose, the European Union adopted the *European climate and energy framework 2030,* which contains important information (also legislative packages of the European Union) on the future direction of European and national climate and energy policies. According to it [3], the EU has set itself the aim of cutting EU greenhouse gas emissions by at least 40% by 2030 from 1990. Also, the proportion of renewables in the final energy consumption of the EU is to rise to 32% and EU primary energy consumption is to be cut by 32.5% compared with a reference scenario.

According to the statistic *"Number of operational reactors in nuclear power plants worldwide by country in January 2019"*[4] published by German statistics database Statista, the United States with 98 reactors (in operation) takes the first place in this ranking. It is further followed by France (58) and China (45). Among the first ten countries are also Japan (40), Russia (36), South Korea (24), India (22), Canada (19), Ukraine (15), United Kingdom (15). Germany has 7 reactors in operation. The statistic shows the number of operational reactors in nuclear power plants worldwide by country. Operable means that the nuclear power plants with the associated reactors are connected to the electricity supply network.

According to another statistic „Distribution of worldwide energy production by energy source in 2016“[5], which shows the worldwide energy consumption, *crude oil* is the world's current largest energy source (32%). From oil is produced not only one third of the world's energy, but it also accounts for the largest share of worldwide energy consumption. To the most consumed energy sources belong also *coal* and *natural gas*. As the amount of nuclear energy in global energy consumption is decreasing, the amount of renewable energy sources on the other hand is growing. The renewable energy source *hydropower* generates only around three percent of the world's energy. The regions with the highest energy consumption are Asia and the Pacific region and with the smallest is Africa. According to different prognosis the global primary energy consumption will continue to rise until 2050.

2 GERMANY AS PIONEER OF THE ENERGY TRANSITION

2.1 Energy transition

Following nuclear accident in Fukushima in March 2011, Germany decided at a rapid race to accelerate the phase-out of nuclear power by 2022. After long years of discussions, it was it was decided on 30 May 2011 to phase out nuclear power. Eight nuclear plants were shut down immediately and the remaining nine will be phased out by 2022. The sequence of shutdown is the following: 2015 Grafenrheinfeld, 2017 Gundremmingen B, 2019 Philippsburg 2, 2021 Grohnde, Brokdorf and Gundremmingen C and 2022 Isar 2, Neckarwestheim 2 and Emsland. Renewable energy is determined as the cornestone of future energy supply. This set of policy instruments is commonly known as the energy transition (ger. "*Energiewende")*. The German term "Energiewende" was first contained in the title of a 1980 publication by the German Öko-Institut, calling for the complete abandonment of nuclear and petroleum energy [4].

In her policy statement [5][6] on the new energy concept on June 9, 2011, the Federal Chancellor Angela Merkel said:

> „Fukushima has changed my attitude to nuclear energy. […] In Fukushima we had to take note that even in a high-tech country like Japan, the risks of nuclear energy cannot be controlled safely"

The energy transition means at the same time withdrawing from nuclear energy and fossil fuels and switching the electricity supply to at least 80% from renewable energies by 2050. The sun and wind should make the biggest contribution. With this decision, Germany is considered a pioneer in this field.

[4] [Anzahl der betriebsfähigen Reaktoren in Kernkraftwerken weltweit nach Ländern im Januar 2019] <https://de.statista.com/statistik/daten/studie/152153/umfrage/anzahl-der-sich-in-betrieb-befindenden-atomkraftwerke-weltweit/> (09.06.2019)
[5] [Verteilung der weltweiten Energieerzeugung nach Energieträger im Jahr 2016] <https://de.statista.com/statistik/daten/studie/167998/umfrage/weltweiter-energiemix-nach-energietraeger/> (09.06.2019)
[6] https://archiv.bundesregierung.de/archiv-de/dokumente/wende-zum-zukunftsstrom-419100 (Letzter Zugriff: 09.06.2011)

> "We can be the first industrialized country in the world that will create the turning point in the energy future." [5]

Energy transition is one of the most ambitious major projects for Germany in the 21 century [6]. Many hope that other countries will realise the advantage of German energy transition and will take an example from Germany.

2.2 Renewable energy in Germany

The electricity supply in Germany is getting „greener" year by year. The share of renewable energy in electricity consumption is growing steadily: from around 6 percent in 2000 to around 36 percent in 2017. By 2025, 40 to 45 percent of the electricity consumed in Germany should come from renewable energy. Crucial for this is the Renewable Energy Sources Act (germ. EEG = Erneuerbare-Energie-Gesetz). According to EEG 2014 [7], the following energy sources belong to renewable energies:

a) hydropower including wave, tidal, salt gradient and flow energy;

b) wind energy;

c) solar radiant energy;

d) geothermal power;

e) Energie aus Biomasse einschließlich Biogas, Biomethan, Deponiegas und Klärgas sowie aus dem biologisch abbaubareren Anteil von Abfällen aus Haushalten und Industrie (§ 5 EEG). energy from biomass including biogas, biomethane, landfill gas and sewage gas as well as from the biodegradable fraction of household and industrial waste.

3 GERMAN ELETRICITY MARKET

Already one third of the electricity in Germany (32.5%) is generated by the sun, wind and biomass. By the year 2025 40 to 45% of the required electricity will be generated from renewable energy sources. Conventional coal and nuclear power plants are losing their importance. A big problem for Germany's largest energy providers, who have been using nuclear power plants, classic gas and coal power plants for years. A big switch for RWE AG, EnBW AG, E. On SE and Vattenfall GmbH. Critics accuse the energy providers of having reacted too late to the changed market conditions.

RWE AG is one of the largest energy providers in Germany. Due to its dominant market position, RWE plays a central role in the energy transition. About the socio-political discourse on the energy transition, RWE's situation is extremely difficult. Compared to the rest of Germany, RWE's energy production still consists of 95% fossil and nuclear sources[7]. RWE, which currently has a majority negative connotation (one of Europe's biggest "CO2 polluters"[8]), is now required to define its role in the energy transition process. RWE must make a shift to significantly more renewable energy sources. So, additional to its power grid, RWE is trying to develop the green electricity business around RWE Innogy. The actual logo of the firm sounds" Powering. Reliable. Future" (germ. "Zukunft. Sicher. Machen")[9]

Not to forget are the energy prices. The energy transition is often criticized for its expensive cost implementation, which is to be paid by energy consumers. Due to the report on energy prices and costs in Europe [8] published in 2019 by the European Commission wholesale energy prices have fallen in recent years due to increasing competition on wholesale markets from big amounts of renewable energy, improved interconnections and a more integrated internal electricity market. Interestingly, that 2018 Germany topped the list if countries with the highest electricity prices worldwide in 2018[10]. Due to the report by the European Commission future electricity production costs are expected to increase for fossil fuel-generated electricity (due to import prices and the carbon price) and fall for renewables (linked to the decreasing costs of investment as technologies evolve), with the

[7] [Anteil der Energieträger an der Stromerzeugung des Energiekonzerns RWE im Jahr 2014] <http://de.statista.com/statistik/daten/stuclie/184795/umfrage/an-teil-der-energietraeger-an-der-stromerzeugung-von-rwe/> (09.06.2019.

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[9] [Official Website of RWE] <https://www.group.rwe/>(09.06.2011)

[10] [Global electricity prices in 2018] https://www.statista.com/statistics/263492/electricity-prices-in-selected-countries/ (09.06.2019)

report suggesting that that electricity market prices could reduce the need for subsidising renewable energy technologies by 2030.

Despite the criticism the energy transition is progressing. It is one of the biggest contemporary energy projects worldwide. Due to its unfinished or progressing status it is not so easy to evaluate correctly all the advantages and disadvantages for the future.

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Processes in Models of the Solution of Tasks of Management of the Enterprises

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Abstract

In article describes main principles of designing of information system for realization of support of decision-making by a management of managing subjects. Also, in the article describers ordering of modern scientific representations about intellectual information technologies in a context of allocation of a subject field of their application.

Keywords: intellectual information technologies, information systems, management of the enterprises.

1 INTRODUCTION

Process of development of the effective unified technique of creation and introduction of the automated system which is characterized by existence of ability of a message a configuration of orders and maintenance of clients to adapt under activity of the company of a certain branch, to consider specifics of production, a possibility of change of system in the shortest terms and also orientations to strategic objectives of the company, still remains insufficiently worked. In article scientific justification of automation of model of the solution of tasks of business management by means of development of a method of formation and development of complex system of economic planning and management is offered which feature is reorganization of business processes at production management, studies dependence of management on character and a condition of the enterprise. Introduction of uniform system of the classification of income and expenses suitable for each business unit, within process of management of production will allow the enterprises to come to essentially new level of efficiency of activity, to distinctly represent under what articles income and expenses of each separate division or the enterprise was distributed.

Deepening of market transformations in economy of the Russian Federation, strengthening of the competition as a result of globalization of the world market, transition of an industrial complex to innovative model of development have significant effect on statement and the solution of new questions in a control system of production. In such conditions information opportunities by means of a combination and development of various elements, methods, models and instruments of planning, modernization of already existing methods raise.

2 REPRESENTATION OF A COMPLEX SOCIAL AND TECHNICAL SYSTEM

The financial structure must correspond to kinds of activity of the company. This approach will allow to estimate results of activity of the enterprise for each direction having the budgets, having provided their effective management.

Integral part of information system is creation of structurally functional model of the solution of problems of planning and management with differentiation of business processes.

Processes are classified on the main and auxiliary. The main processes create new quality of production. Auxiliary processes create infrastructure of the enterprise. The person, responsible for process, has the right to change and improve it and is the owner of process. Borders of process are defined by an interval from the moment preceding the first operation (border of "entrance") and till the moment following the last operation (border of "exit") [1].

The interface of process represents the organizational, technical and information mechanism when which using the interrelation between processes is carried out. Therefore optimization of activity of the enterprise has to be organized business around - processes for the purpose of overcoming their

fragmentariness for achievement of considerable improvements of key indicators Therefore the main objective of creation of the process focused enterprise is allocation business - processes according to grocery lines and functional divisions with their subsequent connection in through processes which are aimed at creation of different types of production. [2]

Each company represents difficult socially - technical system. The concept "system" used in modern practice, has a set of semantic nuances and values. In this regard it is necessary to define the values directly related to the system analysis of activity of the enterprise. The most suitable definitions are given below.

The system has the following integrative properties:

- the variety and distinction of components relates to their functional specificity and autonomy;
- the properties which are absent in separately taken components can be present at system in general;
- structure that means existence established interrelations and the relations between system components, their distribution on hierarchy levels.

Achievement and maintaining desirable result of behavior of system acts as its main objective. Interpretation of the purpose of system in relation to the enterprise - aspiration to optimum result which represents maximizing value of the capital on condition of constant preservation of the established liquidity level, achievement of the goals of production and realization taking into account social tasks. [6]

The main objective of system is the description of a way of achievement of the goal fixed by the expected numerical characteristics. The set of the interconnected purposes represents their system. It is possible to allocate several classifications of systems of the purposes which treat:

- short-term (performance in a year or earlier) and long-term (performance through the period exceeding 1 year) the purposes;
- tactical and strategic objectives;
- financial, production, social purposes, improvement of quality of production and others.

3 MODELING OF BUSINESS PROCESSES

As a result, the system can be characterized as an ordered subset of objects which are interconnected with each other more closely, than with the external environment. An object (an element, a component) is a part of system which is distinguished from the others agrees to the sign formulated by the interested person. [7] The choice of objects and their relationship depends on opinion of the interested person. In that case the enterprise can be considered as a production system, and in the form of organizational and economic or social systems.

Within this approach it is made:

- division of elements into various levels of abstraction (with the limited quantity of elements at each level);
- restriction of a context which has to include only essential details;
- application of strictly certain rules of record;
- stage-by-stage achievement of desirable result.

Conditional reception which allows to present system in the form convenient for perception and also to carry out assessment of its complexity, decomposition is. By means of decomposition there is an allocation of separate structural elements and their interrelations according to certain signs. [9] Use of reception of decomposition allows to avoid possible difficulties in understanding of a subsystem. The dimension and complexity of system, the purpose of modeling determine decomposition depth.

For receiving a complete picture of activity of the enterprise it is necessary to integrate one of the allocated structures taken as a basis with the others as separately taken subsystem is not capable to provide modeling of business processes completely. Usually as a basis information or functional subsystems undertake. Each enterprise possesses considerable number of subsystems that involves existence of many structural elements and communications between them. Any structural element and

communication have specific properties which need to be described. Attributes by means of which it is possible to set qualitative and quantitative characteristics of the modelled elements, for example, the name, the author, a unique code, time and date of creation, costs of function performance, its detailed description belong to the integral properties. Each of the set characteristics is formalized and is applied in the course of carrying out the analysis and drawing up the report.

The model is represented by the set of certain symbols (graphic, mathematical and others) which is adequately describing certain properties of the modelled object and relation between them. The notation is the system of symbols accepted in a certain model. Also, the hardware which realizes the chosen methodology with creation of the existing models considering the notation accepted for concrete model acts as means program.

The models applied for the structural analysis must reflect:

- set of functions, necessary to performance;
- processes which are capable to provide performance of these functions;
- the organizational structures providing performance of functions;
- the required data and the relations between them for performance of the specified functions;
- the material and information streams arising during performance of functions.

It is important to define technical properties which the information system at the enterprise must possess.

Within the solution of objectives, the technique of construction KSEPIU at the enterprise is offered.

The first design stage of system includes decomposition of a complex of problems by reference of each specific objective to above-mentioned groups. At the second stage identification of a method of the decision is made for each group of tasks.

4 CONCLUSIONS

In conclusion it should be noted that as important factors of success of introduction of the automated system support of an innovation from the management and attraction at all stages of end users of system to which they belong both the management and the staff of economic services, and employees of department of information technologies in addition act. [10-11] In case they are involved in process of creation and introduction of system at early stages of its formation, there will be an opportunity to avoid many shortcomings of system regarding discrepancy to qualifying standards and also their interest in achievement of a goal will promote success of the project in general.

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PART IV - EDUCATION AND COMPETENCIES

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Competencies of Experts in Assisting Professions for Psychosocial Work

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Abstract

This paper presents the results of research into the competencies of experts in assisting professions for psychosocial work. The research was carried out in the centers for social work, as the basic institutions in the social protection system of Republic of Srpska. The sample consisted of 100 respondents in assisting professions (psychologists, educators and social workers). The questionnaire investigated their communication, mediation, teamwork and empathy skills, as well as the relationship between competency levels and educational attainment, age and length of service. The results showed that professionals in the assisting professions have a high level of competence for psychosocial work. Lower levels of competence are experienced by older professionals and longer working lives, while their professional competences are not affected by the level of education. Supervision is recognized as an effective way to prevent professional burnout, but also to develop personal and professional competencies. In addition, further training in communication and mediation skills is recommended.

Keywords: competences, psychosocial work, psychology, pedagogy, social work.

1 INTRODUCTION

Bosnia and Herzegovina are one of the poorest countries in Europe, with a 50% general social exclusion index based on indicators reflecting living standards, health, education, participation in society and access to services. This means that every second resident of this country is socially excluded in at least one of these areas. The index of long-term social exclusion is 47%, which refers to the percentage of the population with limited choices to improve their situation over the longer term [1]. With the introduction of the concept of social exclusion, attention was shifted from material to sociopsychological aspects of people's lives. This increases the importance of assisting professions, such as the profession of psychologist, pedagogue or social worker. They take on a key role in aiding and support to people who find themselves in a state of psychosocial need. Their competencies are based on the general characteristics of effective counselors: to have their identity, to respect and value themselves, to be ready for change, to have a sense of humor, to live mostly in the present, to appreciate the influence of culture, to be genuinely interested in the well-being of other people, that they can maintain healthy boundaries (do not bring their own difficulties in the relationship with the user), that they are deep in their business and see the meaning in it [2]. Psychosocial work requires a practitioner who is willing to reject stereotypical roles and be real with the user.

The social protection system is an area in which psychosocial work professionals provide services essential for the empowerment of socially excluded people, families and groups. Responsibility in the field of social protection in Bosnia and Herzegovina is divided into two entities (Republic of Srpska and Federation of BiH), Brcko District and 10 cantons. Since Republic of Srpska has full responsibility for the functioning of the social protection system in its area, this paper examines the competencies of professionals in the assisting professions (psychologists, pedagogues and social workers) in social work centers, as the basic institutions in the social protection system. The method of examining 100 experts in assisting professions from the centers for social work, their competences are investigated for psychosocial work ,(communication skills, mediation skills, teamwork skills and empathy), as well as the correlation of the level of competences with the level of education, age and length of service of professional workers. The aim is to identify the missing competencies and ways to improve them.

2 THEORETICAL FRAMEWORK AND SOCIO-POLITICAL CONTEXT

2.1 The concept of competence and psychosocial work

Although the terms “competent” and “competence” are often identified in the literature, there is a difference between the two. Competent or expertise is a narrower term than competence and refers to the knowledge and skills required to perform work activities according to established standards, while competence is a broader term that indicates what and how people work to reach their goal in the context of the demands of their work [3].

Competencies should be distinguished from the ability and personality traits. One's abilities and traits are individual predispositions that can serve as a basis for acquiring knowledge, skills and competences; knowledge and skills are generally acquired through the education process; competences are acquired by learning in a real work situation, that is, by performing a specific job. This hierarchy is, in fact, an architectural model of competence, taking the form of a Greek temple, in which the abilities, personality traits and other characteristics of the individual form the foundation of the temple, while from them the knowledge, skills and attitudes rise, that bear the roof, composed of general and specific competencies. that is, competence and sub-competence [3].

In short, competencies are “sets of behaviours that are instrumental in the delivery of desired results or outcomes [4].This means that competences refer to an individual's ability to perform certain tasks adequately and effectively in accordance with the expectations we have of him / her as an expert qualified in a field [5].

The competencies of psycho-social work professionals in assisting professions include the possession of specific skills, including communication skills, mediation skills, teamwork skills and empathy.

Communication skills are the skills of expressing thoughts and feelings in a socially acceptable way, that is, leading the conversation in a way that reflects the self-esteem and appreciation of the interviewee. The practitioner should communicate in an assertive manner with tailored non-verbal communication.

Empathy reflects the ability to empathize with another person without disrupting one's own emotional stability. Empathy with the other person, understanding and appreciating their thoughts, experiences and circumstances allows the relationship of trust, motivation and support to open when presenting emotional states. The importance of empathy for psychosocial work is evidenced by the following quote: “The authors' starting position is that emotions, compassion, care and virtues are very important in interventions and that these factors can improve the professional practice of psychologists, health professionals and social workers. We highlight the importance of the relationship between users and professionals in the practices of caring professions” [6].

Teamwork skills imply the ability of cooperation, to work together, to respect each other and to be tolerant, to be rich in the exchange of professional experience, to complement each other, while respecting the diversity of the profession, attitudes and working methods. Teamwork enables complex issues of social protection needs of individuals, families, groups and communities to be viewed, monitored and addressed from multiple points of view - social, economic, health, educational, psychological, legal, etc. Teamwork can be monodisciplinary (experts of the same profession), multidisciplinary (experts of different profiles) and combined.

Mediation, as a third-party neutral mediation process, makes it easier for conflicting parties to find mutually acceptable solutions. By taking on the role of mediator, professionals in the assisting professions can mediate conflict resolution in family relationships, marital disputes, community conflicts, and juvenile delinquency. As impartial mediators of conflict, professionals must have the skills to actively listen, ask questions, and analyze conflict.

This paper explores the competence of psychologists, pedagogues, and social workers for psychosocial work in centers for social work in Republic of Srpska. According to the international definition, "social work is a practice-based profession and academic discipline that promotes social changes and development, social cohesion, as well as the empowerment and liberation of people" [7]. It is observed that one of the tasks of social workers is the empowerment and liberation of people, which is achieved through psychosocial work, which involves focusing on real life situations, so that the user relies on significant persons from their environment (family, neighbors and others). It is a work in which the user has the responsibility, with the help and support of a professional, to change his or her living situation. Professionals work with the user, not for the user.

The goal of psychosocial work is twofold: adjusting the user to the social situation, but also change of the social situation. In both cases, the growth and development of users is important. “Starting with such a definition of psychosocial work, psychotherapy is considered as an integral part of it, as well as a number of other preventive and treatment interventions. At the same time, psychosocial work is considered an integral part of social work, which, in addition to the goals of psychosocial work, also has the task of fostering social change and developing social services and services” [8].

For the purpose of understanding as fully as possible, it should be said that psychosocial work is understood in a narrower and broader sense. More broadly, psychosocial work is the basis, essence of different forms of professional work, if the term "psychosocial" implies human experience created in the relationship between the psychological characteristics of an individual and his social environment, and in the narrow sense, psychosocial work is a kind of model actions of practitioners, dealing with what conditions people live in, what difficulties they encounter, how they experience and survive, how they behave, how they overcome them and how to help them overcome using individual and social environment resources [9]. It is simply about using psychology knowledge and learning about the psychic factors of human behavior and interpersonal relationships.

2.2 Socio-political context

Bosnia and Herzegovina are a complex socio-political community where responsibility in the field of social protection is divided into several levels: two entities (Republic of Srpska and the Federation of BiH), Brcko District and 10 cantons. The Republic of Srpska has full responsibility for the functioning of the social protection system in its area and aids citizens who are incapable of work and lack the means for living. The bearers of social protection are the Republic and the cities and municipalities respectively, which take care of meeting the needs in social protection [10]. In the field of social protection, more than 50 laws and by-laws are applied, which indicates the complexity of this system.

Beneficiaries of social protection rights are persons in social need and are divided into two groups: children (without parental care, with developmental disabilities, whose development is impeded by family circumstances, victims of violence, victims of child trafficking, with socially unacceptable behavior, exposed to socially risky behaviors requiring social protection due to special circumstances) and adults (financially unsafe and incapacitated persons with disabilities, elderly without family care, with socially negative behavior, victims of psychoactive substance abuse, victims of domestic violence, victims of trafficking in human beings and who, due to special circumstances, require social protection) [11].

Professional workers can intervene with cash benefits, provision of social services and other measures that meet social needs, prevent and resolve social problems. It is particularly important the right to counseling that can be exercised by those who need the systematic and programmed support and assistance of professional workers, who, by means of social work and other social and humanistic sciences, overcome the psychosocial problems encountered by the user, such as illness, old age, disability, unemployment, death of loved ones, problems in the upbringing of children and in the relations of parents and children, problems of risky behavior of children and youth, problems of marital and extra-marital relations, domestic violence, involvement of users in daily life after long stay in institutions, etc. [11].

3 METHODOLOGY

The subject of research in this paper is the competence for psychosocial work of experts of three assisting professions (social worker, psychologist and pedagogue) in the centers for social work in Republic of Srpska.

The sample consists of 100 respondents of assisting professions from centers for social work operating in municipalities with different levels of development, which were determined by the Decision on the level of development of local self-government units in Republic of Srpska [12]. Table 1 shows the sample structure.

The research used a scaler test method designed to test the competencies of practitioners to perform psychosocial work. Respondents were offered statements related to the possession of psychosocial work skills (“I have communication skills”, “I have mediation skills”, “I have teamwork skills” and “I am capable of empathy”), which they evaluated as follows: 1 - I agree , 2 - I can't evaluate, 3 - I disagree. The first part of the scaler collects general data on the respondents: municipality and institution (center for social work) in which they work, profession, level of education, age and length of service.

Table 1: Respondent structure

Ordinal number	Criterion	Classification of respondents	Number and percentage of respondents		
			No	%	Total
1.	Development of local self-government units	Extremely underdeveloped	2	2,0%	100
		Underdeveloped	10	10,0%	
		Medium developed	25	25,0%	
		Developed	63	63,0%	
2.	Gender	Male	17	17,0%	100
		female	83	83,0%	
3.	Age	Up to 30	18	18,0%	100
		From 31 to 40	38	38,0%	
		From 41 to 50	8	8,0%	
		from 51 to 60	31	31,0%	
		61 and more	5	5,0%	
4.	Level of education	Higher education	20	20,0%	100
		Fakulty	67	67,0%	
		Master	13	13,0%	
5.	Profession	Social worker	80	80,0%	100
		Psychologist	11	11,0%	
		Pedadgogue	9	9,0%	
6.	Work experience	from 1 to 5	31	31,0%	100
		from 6 to 10	25	25,0%	
		from 11 to 20	17	17,0%	
		from 21 to 30	15	15,0%	
		31 and more	12	12,0%	

Data were processed in SPSS 20 (Statistical Pasckage for the Social Sciences), using the following statistical procedures: frequency (f) and percent (%) calculations; calculation of arithmetic mean (M) and standard deviation (SD); analysis of variance (F-test); Pearson's correlation coefficient calculation (r); calculation of the Kronbach-alpha reliability coefficient (α).

The hypothetical framework consists of one general and four specific hypotheses General hypothesis: Experts in assisting professions have adequate competencies to perform psychosocial work, which depend on their age, level of education and length of service.

The first Special Hypothesis: Professionals in the assisting professions have adequate communication skills, mediation skills in conflict resolution, teamwork skills and empathy.

The second Special Hypothesis: Professionals of assisting young professions have higher levels of competence for psychosocial work.

The third Special Hypothesis: Professionals in the assisting professions, who have a higher level of education, possess a higher level of competence for psychosocial work.

The fourth Special Hypothesis: Professionals of assisting professions with shorter work experience have higher levels of competence for psychosocial work.

4 RESULTS

Within the first specific hypothesis, it was tested whether the professionals in the assisting professions had adequate competences for psychosocial work (communication skills, mediation skills, teamwork skills and empathy).

The results showed that in the assisting professions, empathy is the most common skill (79% agree to possess this skill), then teamwork skills (77% agree), communication skills (71% agree) and mediation skills (64% agree).

Several practitioners expressed hesitancy regarding communication skills (11%), mediation skills (21%), teamwork skills (10%) and empathy (6%). Thus, a certain number of professionals do not have the ability to self-assess their own competencies. Since self-knowledge of one's own competences is a prerequisite for successful psychosocial work, the quality of their professional work is questioned in a smaller number of respondents.

In contrast, some are aware that it is necessary to improve their competences. This is indicated by the data that 18% of respondents believe that they do not possess communication skills, 15% of respondents do not agree that they have mediation and empathy skills, and 12% say that they do not have teamwork skills.

The results related to testing the first special hypothesis confirmed that the professional workers in the assisting professions have adequate competencies for psychosocial work, as most of them agree that they possess empathy, teamwork, communication and mediation skills.

In order to investigate whether the years of life, level of education and years of service of the professionals in the assisting professions affect their competences for psychosocial work, the results on the level of competences for psychosocial work with the following parameters were crossed: age, level of education and years of service. Table 2 shows the results indicating the correlation between psychosocial work competencies and the ages of professionals in assisting professions.

Table 2: Expertise competencies of assisting professions for psychosocial work with respect to age

Variable		**N**	**M**	**SD**	***F***	***p***
	Age of respondents					
Psychosocial competencies	to 30	18	19,17	2,98	3,152	0,018
	31-40	38	19,47	3,50		
	41-50	8	15,75	5,85		
	51-60	31	17,13	3,82		
	61 and more	5	15,80	6,26		
	Total	100	18,21	4,06		

Table 2 shows that there is a significant statistical difference between the competences for psychosocial work and the age of the respondents (F = 3.152; p = 0.018). Respondents aged 31 to 40 years (M = 19.47; SD = 3.50) have the highest level of competencies, and the lowest levels of competences for psychosocial work are those aged 41 to 50 (M = 15.75; SD = 5.85) and 61 and older (M = 15.80; SD = 6.26).

This confirms the second specific hypothesis, according to which professionals in the assisting professions of younger age possess higher levels of competence for psychosocial work.

The following table (Table 3) shows the impact of education level on the development of psychosocial competencies.

Table 3: Competences of experts in assisting professions for psychosocial work about educational level

Variable		N	M	SD	*F*	*p*
Competences for psychosocial work	***Level of education***					
	High school	20	18,45	3,19	0,942	0,393
	Fakulty	67	18,42	4,15		
	Master's degree	13	16,77	4,73		
	total	100	18,21	4,06		

Based on the presented results (Table 3), it is concluded that the level of education of the respondents does not determine their competence for psychosocial work, i.e. that this difference is not statistically significant (F = 0.942; p = 0.393). Respondents with higher education (Masters) have a lower level of psychosocial competences (M = 16,77; SD = 4,73) compared to respondents with a lower educational level or higher education (M = 18,45; SD = 3 , 19) and faculty (M = 18.42; SD = 4.15).

Therefore, the third specific hypothesis according to which experts of assisting professions with higher education level, owned higher level of competence for psychosocial work, was not confirmed.

Table 4 shows how seniority is used at the level of psychosocial competencies of professionals in the assisting professions.

Table 4: Psychosocial work competences with respect to years of professional experience in assisting professions

Variable		N	M	SD	*F*	*p*
Psychosocial work competencess	***Years of service***					
	to 5	31	18,68	3,55	1,517	0,204
	6 - 10	25	19,20	4,15		
	11 - 20	17	17,24	4,49		
	21 - 30	15	18,33	3,09		
	31 and more	12	16,17	5,06		
	total	100	18,21	4,06		

Based on the presentation (Table 4), it is observed that the difference between the psychosocial work competences and the years of work experience of the respondents has no statistical significance (F = 1,517; p = 0.204). However, the results show that the lowest level of psychosocial competences is found in the respondents with 31 years and more years of work experience (M = 16.17; SD = 5.06), and the respondents with between six and 10 years of experience have the highest level of psychosocial competences . This has proven that professionals in assisting professions with shorter work experience have higher levels of competence for psychosocial work.

Based on the results of the research, it can be concluded that the professionals in the assisting professions have adequate competencies for performing psychosocial work, whereby professionals of younger age and shorter work experience have more developed competencies, while the degree of education is not crucial for competent performance of psychosocial work.

5 CONCLUSIONS

Most professionals in the assisting professions were found to possess empathy skills (79%), while 15% felt they did not possess this ability and 6% could not evaluate. This points to the need to develop the capacity to empathize with social work beneficiaries, since having empathy is a central competence for successful psychosocial work and a prerequisite for developing other qualities of the assisting process.

The high percentage of professionals possessing teamwork skills (77%) is in line with the fact that many centers of psychosocial work have developed long-term teamwork practices in many psychosocial work centers, resulting in most professionals having acquired this skill.

Most professionals in the assisting professions (71%) have mastered communication skills. For those who think they lack this skill (18%) and those who cannot assess whether they possess it (11%), additional training should be provided to develop skills such as active listening, asking open and closed questions, paraphrasing, reshaping, summarizing etc.

A significant percentage of skilled workers (36%) consider that they are not competent enough for the role of mediator. This indicates the need for skilled workers to go through a formal training process for a mediator. Moreover, in their daily work, they often play the role of mediators in resolving conflicts between the user and various factors in their social environment.

Younger and part-time respondents have a higher level of competence for psychosocial work than older and longer-term respondents. Due to many years of work in the profession, older professionals are more prone to professional combustion, while in younger ones the degree of professional combustion is lower and the enthusiasm and motivation for applying psychosocial work skills is higher. This can be considered a crucial factor, as long as the results of the research show that the level of formal education is not crucial to the competencies of psychosocial work professionals.

In order to prevent professional burnout and enhance professional competences for psychosocial work, professionals in the assisting professions should be provided with a specific type of training that empowers them as individuals and professionals. Supervision plays an indispensable role in this. Supervision plays a key role in the sense of competence and adult learning and is a process in which professionals develop self-esteem based on formed personal and professional identities [13]. The goal of supervision is to develop professional competence, which enables professionals to integrate their professional experience with the theories and requirements of their professional role, on the one hand, and with their traits, values, feelings and predispositions, on the other.

This form of support is also a legal obligation. "Social protection institutions are obliged to provide conditions for the introduction of supervision to professional workers and workers in other social protection activities, which provide organized and continuous professional support for better and more professional performance of services and provision of services to beneficiaries" [11]. Despite the legal obligation, this form of support in the centers for social work of the Republic of Srpska did not take effect. The use of supervision would encourage the personal growth of professionals and further develop their competences for psychosocial work. Today, supervision is a professional intervention necessary for the professional development of all those who work directly with people, especially people in assisting professions.

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Effect of Educational Level on Cognitive Abilities of Elderly

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Abstract

The research was conducted to examine the impact of educational level on the functional cognitive abilities of the elderly. The sample consisted of 70 participants, older than 60 years. The participants were divided into two groups, participants with dementia, and participants without dementia. All participants responded individually, on the questions in Arizona Battery for Communication Disorders of Dementia (ABCD). The results have shown that educational level significantly predicted functional cognitive abilities. Education influences the creation of cognitive reserves. Bigger cognitive reserves mean a slower progression of the cognitive decline, which is especially important for people with dementia.

Keywords: cognitive abilities, education, elderly, dementia

1 INTRODUCTION

Aging is a process that is accompanied by changes in an individual's cognitive competencies and functionality. In the developed countries of the world, there has been an increase in life expectancy, and this increase is both a social achievement and a challenge [1]. An individual's health and quality of life are closely linked to a person's cognitive functioning [2]. Several factors can affect one's cognitive functioning, but especially interesting are those that appear to have a positive relationship to development or may be classified as prevention factors. A person's level of education is one of the factors that influence cognitive functioning and is receiving great attention [3],[4],[5].

Researchers around the world are researching older people's cognitive functioning because they believe that cognitive function has a significant impact on the quality of life [6]. Cognitive changes can affect a person's day-to-day functioning, and a better understanding of the process of cognition can help clinicians distinguish normal from disease states [7].

Cognitive processes include products of modular processing between stimuli and responses and are derived from, among others, language-related knowledge. Other cognitive processes include attention, awareness, cognition, communication, executive, language, memory, perception, problem solving, reasoning [8]. From the behavior of a person, it can be deduced which processes are in the background of cognition, or which processes are disrupted [9]. Many studies suggest that elderly have more difficulty learning new content, exhibit less effective thinking skills, respond more slowly to all types of cognitive tasks, and are more sensitive to interfering information than younger adults [10].

Mild cognitive impairment and dementia are conditions in which the decline in cognitive abilities is very manifesting in the clinical picture. Mild cognitive impairment is a condition between normal cognition and dementia, in which functional abilities are preserved [11]. Dementia indicates a disorder of cognitive activity resulting from changes in brain function [12]. However, even the elderly who do not have mild cognitive impairment or dementia may experience subtle aging-related cognitive changes [7]. Unfortunately, these changes often remain unrecognized by family members or caregivers [2].

The aim of this research was to examine the impact of educational level on the functional cognitive abilities of the elderly.

2 METHODOLOGY

2.1 Participants

The study included 70 participants, over 60 years of age. The subjects were divided into two groups, subjects with dementia (N=40) and subjects without dementia (N=30). The average age of participants with dementia was 80 years and one month, while the average age of participants without dementia was 78 years and one month. This average difference of two years with a 95% confidence level was not significant ($t=1.54$; $df=68$; $p=0.128$). The total sample consisted of more female (70%) than male respondents (30%). The results of the chi-square test showed that there was no significant difference in gender representation ($\chi2=0.625$; $df=1$; $p=0.429$).

Medical records were used to determine the presence or the absence of dementia and causes (vascular dementia and dementia due to Alzheimer's disease).

3 RESEARCH TOOLS AND DATA COLLECTION

The research was conducted in health care and social care institutions. Arizona Battery for Communication Disorders of Dementia (ABCD) (Bayles and Tomoeda, 1993) was applied to determine functional abilities. ABCD examines five areas: mental status, episodic memory, linguistic expression, linguistic understanding (language comprehension) and visuospatial construction. All respondents were individually examined.

The examiner paid attention to conditions that may affect the test results, such as auditory word discrimination deficit, visual-perceptual problems, visual agnosia, illiteracy, depression, and apraxia. To assist the examiner in identifying these difficulties, the ABCD battery contains screening tasks: Speech Discrimination, Visual Perception and Literacy, Visual Field, and Visual Agnosia. The Hamilton Depression Rating Scale (Hamilton, 1960) was used for screening for depression, and the Western Aphasia Battery-Revised (Kertesz, 2007) for scanning apraxia. Respondents who had a deficit of auditory word discrimination, visual-perceptual problems, visual agnosia, who were illiterate, depressed (score above 13), or apraxic were excluded from the examination.

Participants had no history of neurological and psychiatric illness, and no history of alcohol or drug abuse. Data of educational level were obtained from the participants without dementia themselves, or the caregivers for participants with dementia.

All the participants provided signed informed consent before they were subjected to the research procedures. For respondents with dementia, written consent was given from caregivers.

3.1 Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS®) software package version 24.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics parameters were calculated. The Chi-squared test was used for testing differences between two groups of participants in relation to gender and educational level. Linear regresion analyses was used to predict relationship between educational level of participants and their functional cognitive abilities. A statistical level of 95% ($p<0.05$) was considered the significance limit for all statistical tests.

4 RESULTS AND DISCUSSION

The analysis of the educational status of the participants shows that the most participants in both groups had completed elementary school (51.4%), followed by high school (32.9%), while only one respondent without dementia had a college degree (Table 1). The comparison of the study groups did not reveal any significant difference between the respondents in the educational level ($\chi2=2.26$; $df=3$; $p=0.52$). The number of illiterate persons older than 10 years of age, marked since 1971, was 23.2%, has been steadily declining to 2.8% in 2013 [16]. Although Bosnia and Herzegovina is today among the countries where adult literacy rates are near 100% according to UNESCO Institute for Statitics (UIS) data [17], the majority of older people living in Bosnia and Herzegovina and the surrounding countries have a lower level of education (illiterate, only basic knowledge in reading and writing or have primary school) [18,19].

Table1. Frequency of participant with and without dementia in relation to Educational level

			Level of Education				Total
			Reading and writing without formal education	Primary (elementary) school (8 years total)	High school (11-12 years total)	College and University degree (>12 years total)	
Group	Participants with dementia	N	7	21	12	-	40
		%	17.5%	52.5%	30%	-	100%
	Participants without dementia	N	3	15	11	1	30
		%	10%	50%	36.7%	3.3%	100%
Total		N	10	36	23	1	70
		%	14.3%	51.4%	32.9%	1.4%	100%

Analyzing the educational status of participants by gender, it can be seen that most of the female respondents in both groups had completed primary school, with more female participants who had no formal educations, but only basic skills in reading and writing in the group with dementia. Male respondents without dementia were slightly more educated than those with dementia (Fig.1 and Fig.2).

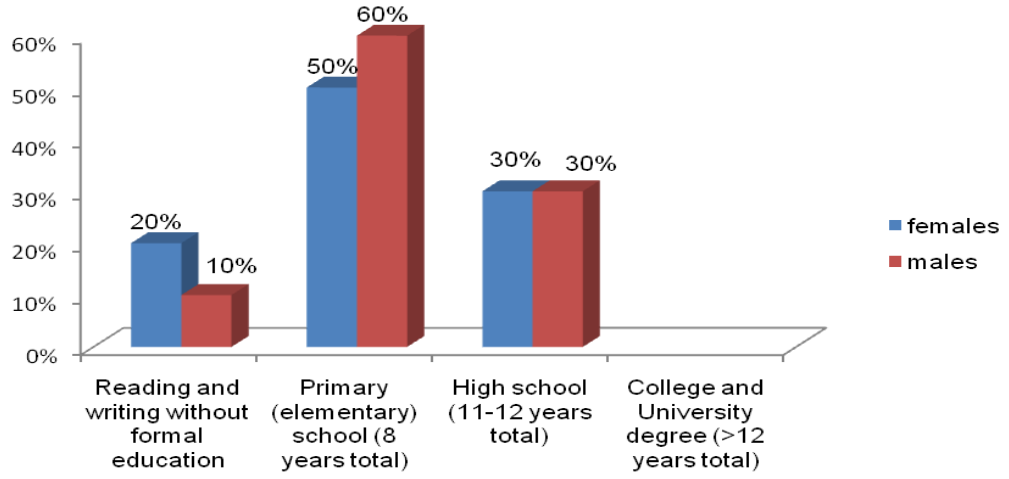

Fig 1. Educational level of participants with dementia in relation to gender

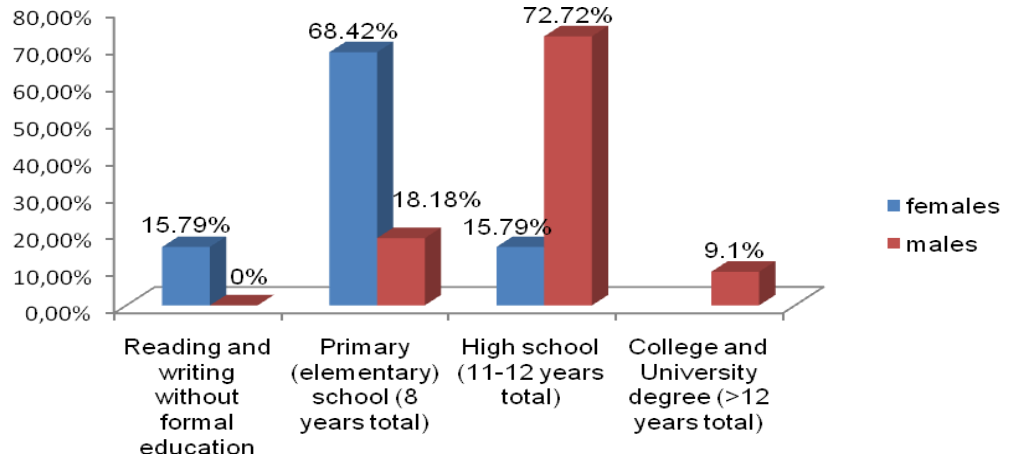

Fig 2. Educational level of participants without dementia in relation to gender

Female respondents in this study had a lower educational level, while male respondents were more likely to have completed high school or college. These results are in line with data from the Agency for Statistics B&H [16], which states about 0.8% of illiterate men and 4.8% illiterate women. Even though

the number of literate people in the world is constantly increasing, according to the UIS [17] data from 2016, 750 million adults are still lacking in reading and writing skills, of which two-thirds are females. The backwardness of women at lower levels of education is drastic [18]. The increased number of elderly women with dementia who have not had formal education indicates the possibility of the impact of early deprivation, perhaps a lower brain "reserve", which allowed dementia to occur at an earlier age [20].

Linear regression analysis was used to test if educational level significantly predicts participant's functional cognitive abilities. The results of the regression indicated the educational level in the group of participants with dementia (Table 2) explained 35.3% of the variance (R^2=0.353, F(1,38)=5.4, p<0.025). It was found that education level significantly predicted functional cognitive abilities (β=0.35, p<0.025).

In the present study, the significant positive impact of education level on the functional cognitive skills of the respondents was maintained in the group of respondents with dementia. Education, age, and cultural background are factors that can have an important impact on cognitive functioning and behavior [21]. Education is thought to be associated with better cognitive performance. However, the link between educational level and aging-related cognitive changes is still not fully understood and there are conflicting findings [22, 23]. People with better education generally also have better living conditions, healthier lifestyles and have easier access to health services [24].

Table 2. Regression analysis summary for level of education predicting Total functional cognitive abilities in participants with dementia

Variable	B	95% CI	β	t	p
(Constant)	12.3	[10.69 13.91]		15.44	<0.001
Level of Education	1.41	[0.18, 2.64]	0.35	2.32	0.025

Model	R	R Square	Adjusted R Square	Std. Er.E	df	F
1	0.353	0.125	0.10	2.6	1,38	5.4

However, in the group of participants without dementia (Table 3) thus it was not found that educational level significantly predicted functional cognitive abilities (β =0.3, p<0.114). The results of the regression indicated the educational level in the group of participants without dementia explained 29.5% of the variance (R2=0.295, F(1,28)=2.7, p<0.114).

The subject of researches for many years is how the level of education has related to a higher prevalence in persons with dementia [25]. A higher rate of illiterate people 15.67% versus 7.16% of literate people were found in six countries with dementia respondents in Latin America [26]. García et al. [25] from Spain found a similar relationship between illiterate and literate people with dementia. The risk of developing dementia decreases with educational level increasing. Dementia is more commonly diagnosed in people with lower educational status, while it is less commonly reported in persons with higher education [27]. Accordingly, illiteracy can significantly affect cognitive performance [28]. A higher level of education means that a person is more likely to compensate for the difficulties that are arising from neurodegenerative changes [29]. Highly educated individuals are more tolerant of neurodegenerative pathological processes and are less likely to suffer from dementia for this reason. Even after stroke, there are fewer individuals with high education who will develop dementia [24]. A lower level of education is among the major risk factors for Alzheimer's type of dementia. Higher educational level can therefore be classified as a prevention factor. The first signs of cognitive decline can be seen in highly educated subjects as early as 15 to 16 years before the development of dementia. In people with lower educational status, the first signs of cognitive decline may be observed slightly later, about seven years before the development of dementia [30]. A study of 872 brain donors found that higher levels of education were associated with a reduced risk of dementia. Although a higher level of education did not protect individuals from developing vascular and neurodegenerative pathology, it did seem to mitigate the impact of pathology on the development of dementia [23]. Although cognitive performance is not directly related to reading and writing skills, it is related to verbalization and skills that are learned and further enhanced during the school [31]. Education can affect a person's vocabulary and other cognitive abilities. Lower educational level is a predictor of lower results on language and knowledge tests [29]. Level of education, in addition to aging and gender, is cited as a very significant factor in the onset of dementia [20]. Schooling has a significant impact on the mechanisms of cognition, and in this context, illiteracy becomes much more than an inability to read and write [25]. The cognitive abilities of illiterate people measured by standard neuropsychological tests are significantly affected by schooling. Literacy, in a way, changes the brain's organization of cognition [32].

There are many factors that may be associated with a higher prevalence of dementia in illiterate persons, such as low cognitive reserves, insufficient risk control for cerebrovascular disease, difficulties in cognitive evaluation, and poor adaptation of neuropsychological tests for a specific population, but also income, socioeconomic factors, type of childhood development, life expectancy [25].

Table 3. Regression analysis summary for level of education predicting total functional cognitive abilities in participants without dementia

Variable	B	95% CI	β	t	p
(Constant)	21	[20.39 21.67]		64.65	<0.001
Level of Education	0.35	[-0.09, 0.8]	0.3	1.63	0.114

Model	R	R Square	Adjusted R Square	Std. Er.E	df	F
1	0.295	0.087	0.05	0.83	1,28	2.7

5 CONCLUSIONS

Changes that occur in the brain during aging can lead to a person's cognitive decline, however, certain factors can slow or reduce that decline. The results of this study showed that the majority of older respondents in Bosnia and Herzegovina have completed primary school or possess only basic reading and writing skills, without formal education. The elderly men are slightly ahead of the women, and more often have completed high school or college. Older men with no dementia have a slightly higher educational level than older people with dementia. The level of education was found to significantly predict functional cognitive abilities. Higher levels of education are related to stronger cognitive reserves, which is especially important for people with dementia at some point in their lives. These cognitive reserves can mean a slower progression of the disease and longer retention of independence in performing daily tasks and activities, which is one of the goals of treatment for people with dementia. It should also be emphasized that besides of having a positive impact on cognitive abilities, education has positive effects on the social status of the person as well as the economic development of the country, which should be a priority for countries with low economic status such as Bosnia and Herzegovina. By investing in a person's education, we invest in the future, because not only does it improve the economic status of a country, it also improves the quality of life of its inhabitants and is prevention factor for certain diseases that develop in old age.

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Youth, Work and Education: Sociological Research of Full-Time Students at the University of Split

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Abstract

In the Republic of Croatia, there is an increasing trend of employment during full-time studies. Starting from the question of what motivates full-time students to work, the aim of this paper is to examine and analyze the sociodemographic characteristics of full-time students of the University of Split who use the services of the Student Center as well as their work-related experiences during their studies. The survey was conducted during July and August 2019 on a sample of 216 full-time students at the University of Split. The results of the research show that students are partially satisfied with the salary paid by their employer, and that they earn half of their monthly income through the Student Center, while the rest is contributed by parents. Still, a fifth of students receive most of their monthly income from a parent or scholarship, so even though they receive scholarships, they are still forced to be employed. Half of the students have an average hourly rate income of 2.69 to 3.37 euros, which is also the minimum fee. A third of students think that their work is less time consuming, and the same percentage of those students' state that their work does not take the time allotted for teaching and learning. They are mostly motivated to work during their studies by their poor financial situation, but also by meeting their own needs in the form of buying modern technology, clothing and footwear and going on trips. However, many students choose to work during their studies in order to gain new experiences and knowledge.

Keywords: full-time students, work during studies, employers, Student Center, motivation

1 INTRODUCTION: STUDENTS' REASONS AND MOTIVATION TO WORK DURING THE STUDY

The modern generation of young people in Croatia matures under general social conditions that are significantly different from those of the earlier generations of young people. This difference is conditioned by the economic crisis that began in developed parts of the world in 2008, and in the meantime has spread to other areas of social life. The crisis also affected Croatia. The situation of young people is further aggravated by the circumstances of growing up in a transitional society, with only two decades of building a democratic social and political order and the difficult experience of war on its own territory whose material, social and political consequences are still present.They are young, directed to assume their intended social roles and tasks, and their innovative and creative contribution is expected.Therefore, within the youth population, students can be seen as the most sensitive segment of social movements, and as potential bearers of new trends that will, to a greater or lesser extent, be extended to other segments of youth [1].

The average level of education of the Croatian population has been increasing over generations. Gender disparities in educational attainment have decreased significantly over time. It seems that education is still not equally available to everyone. Namely, statistical chronicles show that young people of higher social origin (from the most urbanized areas and the most developed regions, especially with a university-educated father) are more likely to reach a higher level of education. There is also an evident tendency toward longer studying (15% of all students are over 25 years old), as well as toward an easier employment of young people with university degrees than those without qualifications [2].

Furthermore, Potočnik notes that, based on the results of a study of professional aspirations, Croatian students show a certain lack of highly ambitious goals. Also, most students emphasize the importance of traditional goals aimed at a 'neat' and 'regular' path to building a professional career and life, or to graduation, finding jobs and existence assurance. Therefore, the reasons for their study choice are

consistent with professional aspirations. Specifically, only two-fifths of students enrolled in a study because they liked the subject of the study. They are followed by the students who “generally wanted to study” and a quarter of students enrolled in a study appropriate to their high school orientation. Finally, one-fifth of students stated that enrollment was not their first choice, but they continued their studies and were satisfied with their selection [3].

Most of the Croatian students belong to families whose monthly income per member usually range from 200 to 337 euros which in the case of students living outside their parents' home may represent an insufficient basis for independent living. For this reason, some students are forced to work regularly or frequently to maintain their existence. The regularity of students’ own work can have multiple implications not only for the current economic status of students, but also in the formation of their work habits, while it may negatively affect and prolonged study time or they might even drop out. Data on professional aspirations and the world of work in the eyes of students show that two fifths of students who work occasionally usually do that in order to complement their home budget. Only a relatively small proportion of students regularly support themselves with their own work, while a third of students are completely exempt from paid work [3].[1]

There is an interesting difference in the regularity of paid work regarding the type of finished high school, since the students of vocational and technical schools mostly abstain themselves by their own work. There are also differences regarding the year of study. There is a higher number of students of the first three years who work in comparison with a slight decrease of a number fourth- and fifth-year students who work. Considering the field of study, it is noticeable that among the students of biomedical sciences there is the highest number of those who never or only occasionally support themselves with their work, while the students of biotechnical, technical and social sciences are the first among those who started their regular or regulary paid work relatively early [3].

Generally, there is also an increase in the number of part-time or full-time students. Two trends that all colleges and universities will have to face are students who spend less time studying and more time working. Lowering of academic standards by rewarding minimal effort and achievement (expecting less) is certainly a short-term strategy, but it will have negative long-term consequences. A more productive way to address these issues is to conduct empirical research to determine the extent to which these trends will adversely affect students' academic performance and use the results to enhance academic programs [4].

Students' motivations for employment during their studies are foremost related to the financing of their education, especially if we consider the increasing involvement of students from lower-income families in higher education or those with a lack of family support. Second, for many students, the only reason to combine work and education is to spend income on social and leisure activities. However, few students employed during their studies experience work as a form of human capital investment in their future professional development. Čavar states that it is necessary to study precisely the effects of work on employment and that it is also necessary to define a threshold for high-intensity work. While some authors define it as more than 24 or 25 hours per week, other thresholds are much lower and range from working hours of 8 to 12 hours per week [5].

Working and studying is a normal occurrence in many countries that participated in EURO STUDENT research. Specifically, more than 50% of university students work in 50% of the countries surveyed. In Croatia, according to EURO STUDENT data, 45% of students did some paid full-time or part-time work during the semester in which the survey was conducted. The proportion of full-time employees is significantly higher among the students of professional studies (29%) compared to university studies (12%). Female students are slightly more prevalent among those who did not do some paid work during the semester. Out of the total number of male students, 51% did not work, while 59% of female

[1] Students’ employment in Croatia is legally regulated only in the case of full-time student work, namely by the Act on Scientific Activity and Higher Education, the Regulations on Intermediaries for Employment of Full-time Students, the Law on Mediation in Employment of Full-time Students, and the Act on Pension Insurance and the Contribution Act. According to these acts, full-time students are entitled to employment through student service centers, which are responsible for keeping records of their members, as well as appropriate processing of the student labor market, calculation and payment of student earnings, required contribution and mediation fees, and free payment of student salary. Such regulated employment of students is not subject to the provisions of the Labor Law and is a special form of work, not related to employment. The performance of a job by a student involves the use of a work contract, ie a student work contract. This is one of the biggest problems with student work arrangements, since it has all the characteristics of an employment relationship but is not classified as such. The only difference between student and full-time employment is its duration, since student work is usually temporary and of short duration. In this way, student employment is a kind of exception that is allowed, since the current structure usually favors students, Student Centers and employers, since students are their parents' ‘‘tax breaks’’, a source of income for Student Centers and cheap labor for employers [5].

students did some paid work during the semester. Most students (77%) who are over 30 years have a full-time job anlongside with their studies, while on the other hand, they rarely work part-time. Student who are parents, are also much more likely to be over the age of 30, are more likely to be full-time, as are part-time students. Interestingly, students who rate their social status as low (23%), as well as students whose parents completed only elementary school (41%), were more likely to work full time during the semester. Higher employment during the studies of students whose parents are poorly educated has also been demonstrated in several other countries described in the previous international EURO STUDENT report. In a slightly longer period, over the past year, 49% of university students and 60% of professional students have been enrolled in paid jobs [6].

Student engagement in work also has negative effects. There is a clear trade-off between work and study, and college students use significantly less time to study. Working during the semester can interfere with learning and academic success and can even encourage students to leave college. Unless enrollment in a university is restricted, work usually leads to a longer study time [8]. According to some studies, students spend less and less time studying. A study conducted by the Research Institute for Higher Education at UCLA's College of Education and Information Studies found that only 34% of the first-year students spent six or more hours a week outside of academic work (e.g. doing homework, studying) during their final year in high school. The sample consisted of 276,449 respondents at 413 four-year colleges and universities in the country (more than one quarter of enrolled first year students in the USA) [4].

Farnell also points out that the workload of students who work and those who do not work varies significantly. Specifically, work may reduce the time available for attending the study and the study. Students who worked intermittently during the semester attended, on average, one hour less and taught 1.4 hours less than the students who did not work. This difference is not big, and the average weekly workload and study time of 46.8 hours still falls within the scope of normal weekly working hours. However, the analysis of students who worked full-time during the semester showed large differences. They spend on average 8.6 hours a week less studying or attending classes, which is 25% less than non-working students. At the same time, they work on average 33.8 hours per week, therefore, almost a full-time work, which, together with the hours of learnig and attending lectures teaching and teaching, makes an extremely high 60.1 hours per week [6].

Data from a survey of professional aspirations of Croatian students and their experience in the labor market show that almost three quarters of the 2010 sample students have part-time work experience, while a further 7% wanted to work but without success. However, less than a fifth of students did not want to work at all, indicating that most students in Croatia prefer to work during their studies [3].Students who have not expressed a desire to participate in the labor market during their studies are from smaller cities and relatively most of them study at the University of Osijek and are generally in their final years of study. Similarly, unlike students who were unable to find a job or take part-time work, they achieve excellent success [3].

Furthermore, Potočnik points out that if we consider the EURO STUDENT research data (2011), which found differences in the incidence of paid work among undergraduate students in Europe, we conclude that Croatian students still participate less frequently than their European counterparts. Students from Poland, the Czech Republic, Estonia and Slovakia are on the top levels of those who spend lots of time on paid work, while students in Turkey, Croatia and France have devoted the least amount of time to work. On the other hand, students of graduated studies in all countries spend more time on average than undergraduate students, except in Sweden, Croatia and France [3].

Čavar points that the student population has grown more heterogeneous and numerous over the years, and that the massification[2] of higher education has the potential to reduce the quality of education, increase government spending on education, a disproportionate structural labor market, and youth unemployment. These structural changes in higher education are causing over-graduation, especially in particular fields of study, and the increasingly competitive graduate market, where higher education certificates are losing importance and work experience becomes an important signal of high

[2] The higher education massification is very present in Croatia. Specifically, the student population grew for 82% between 1990 and 2005. This information alone would not be so problematic if this expansion was not concentrated mainly in the field of social sciences and humanities, outside university courses and among part-time students, ie mainly students who pay tuition fees. Since 2000, the share of private tuition fees has exceeded 20% of the total cost of higher education, and public funding has been reduced. According to the Ministry of Science and Education, about 65,000 full-time students do not pay tuition a year, nearly 60,000 pay a certain amount, and 39 724 part-time students pay full tuition. In other words, 60% of students pay tuition, which is a big increase from 1993/1994, when the proportion of those students was 12%. Because the scholarship fund is not large since less than 7,000 scholarships are awarded by the state and universities, a large number of students depend on the financial support of their parents as well as on student part-time or full-time work [5].

productivity. In this way, part-time employment becomes a way for students to acquire additional transferable skills (ie additional investment in human capital) and differentiate themselves from the "mass" [5].

Working while studying is a part of daily life for a large part of European students. The proportion of employed students varies from 48% in France to 77% in the Netherlands. On average, European students spend 11 hours a week in the workplace and receive between 31 and 54 percent of their total employment income [7]. Finland is no exception as far as student recruitment is concerned, as half of Finnish students are employed during their studies. From a societal standpoint, students provide a flexible work reserve. In other words, working students often work part-time and can adjust their working hours to their current employment. In most fields of study, university education does not prepare students for one specific job and, therefore, appropriate work experience can be the key for finding a job after graduation [8]. According to a 2013 Youth Perspectives Study, two-fifths of employed young people do not work in the profession they are educated for, and although those with higher education have a better chance of getting a job in their profession, they seem unsure about finding a job at all after graduation, especially those living in cities and senior students [5].[3]

1.1 Student-employer relations

The most used means of establishing employer-student collaboration is students' proactive contact with a prospective employer. Both students and employers prefer their own personal relationships when considering potential collaboration. Employers prefer to contact academic institutions to find suitable candidates, as opposed to students who do not do that often. Contacting candidates through specialized ads and specialized student ads is more popular with students than with employers. When it comes to using social networks to find candidates, employers are more inclined to use them than students [9]. Employers usually offer students internships and collaborations on inter-organizational projects and, to a lesser extent, student affairs, teaching and collaboration on student projects. However, students often contact employers to find student jobs and internships, and a smaller number of student contact the employer to collaborate on inter-organizational projects and tutoring [9].

An empirical analysis of the characteristics of students' interaction with employers conducted on a sample of employers in the Zagreb area and students of the University of Zagreb has shown that students, as well as employers, rely on students' proactive behavior in job search, internships and teaching, and both often rely on personal contacts in the process of finding promising candidates. Students are generally interested in student affairs, and employers often offer these opportunities with internships and apprenticeships. Given the criteria used in the candidate selection process, employers particularly emphasize the importance of students' formal and informal knowledge and skills as well as personal interests. Employers do not consider previous work or volunteer experience to be a determining factor in the selection process. Students, on the other hand, prefer positions where they can apply their informal knowledge and where assigned activities are closely related to their fields of study [9].

Part-time and temporary jobs are very suitable for the 15-24 age group. These forms are attractive to young people because they allow them to combine work with education. Organization of part-time and temporary jobs creates the potential for increasing youth employment [10]. Part-time employment is most attractive to students, women (with family and especially children), people who will soon retire. Due to greater flexibility in working hours and more leisure time, people tend to opt for part-time employment. However, the exceptions are young people who work part-time because they have not found a full-time job. Many countries promote this form of employment because the level of part-time employment can produce significant results for increasing the number of jobs at a given volume of work [10].

An analysis of the legal framework of student work and its usage patterns reveals, as Čavar points out, several irregularities. First, student work is not subject to the provisions of the Labor Act, which means that students do not have the same rights and privileges as full-time workers, which, combined with the relative financial availability of that type of work for employers, can lead to the exploitation of student workers. Another form of legal malpractice relates to the high number of hours and large

[3] Although the general unemployment rate in Croatia is the most significant issue for the Croatian economy, young people are those who are particularly affected by it and those who are fast becoming the most vulnerable group in the labor market. In 2016, the youth unemployment rate in Croatia was one of the highest in the European Union and amounted to 31.3%, while the average youth unemployment rate in the same year was 18.7%. Although lower, the unemployment rate of young people with tertiary education in Croatia is quite high, reaching 28.7% in 2016, significantly above the EU average of 13.8% [5].

revenue generated by such contracts, since there are no prescribed limits on them. In addition, employers often use student contracts to pay for work performed by students. Second, as can be seen in the overview of student job offers, most of the jobs that students do are not different from the standard full-time jobs performed by full-time workers, which entails two problems: one relating to students and the other to full-time employees [5]. In this way, students, as a cheap workforce, can easily replace dismissed or unemployed people, especially unskilled ones. On the other hand, students employed in the trade and service sectors can hardly acquire any relevant professional competence, especially if their fields of study are not in any way related to those sectors. So, the student can profit from their fixed-term jobs in the way that would be infrequent from student practice, leading to the conclusion that a student workforce contract in its current form largely meets the needs of employers [5].

2 METHODOLOGY

2.1 Research Objectives

The general objective of the research is to examine and analyze the sociodemographic characteristics of full-time students of the University of Split who use the services of the Student Center (SC) and their experiences related to work during their studies. Specific research goals are: 1. to investigate students' motivation to work during full-time study; 2. to examine the impact of student work on academic achievement; 3. to determine students' satisfaction with SC jobs; 4. to examine students' satisfaction with the pay and employers; 5. to determine attitudes on the exploitation of students by employers.

2.2 Research Hypotheses

In accordance with the set goals, the following research hypotheses were set:

H1: There is no difference between women and men in terms of job satisfaction conducted through SC.

H2: There is no difference between women and men in terms of students' exploitation in students' work.

H3: Women consider that they have higher monthly earnings than men.

H4: Men consider that they have less time to fulfill their academic responsibilities than women.

2.3 Method and sample

For the purposes of this paper, a survey was conducted during July and August 2019. The study involved 216 full-time students at the University of Split, of whom 128 were women (59.3%) and 88 were men (40.7%). A 2% sample of all University of Split students who were employed through SC in the 2017/2018 academic year was used (N=10.798). Most respondents belong to the age group 19 to 22 years (58.9%), and are mostly students of undergraduate studies, followed by graduate students in the age group of 23 to 25 years (39.3%), and the group of 26 to 27 years (1.9%). Most of them study in the field of social sciences (47.2%), followed by technical sciences (25.5%). There are 11.6% of students studying arts, and the least studying natural sciences (8.8%) and biomedicine and health (6.9%). Most (93.1%) of the respondents live in the city, while only 6.9% in the countryside. Less than half (44.4%) of students live with a roommate, 42.1% in a parental home, and fewer live alone (6.9%) or with a partner (6.5%).

3 RESULTS

The Republic of Croatia belongs to countries where work during regular study is a generally acceptable thing. One reason is certainly the circumstances of growing up in a transitional society, accompanied by the still-felt 2008 economic crisis. According to this survey, half (50.5%) of students are currently employed through SC, a quarter (25.9%) were employed in the last academic year (2017/2018), while 23.6% students are in permanent employment. Slighty less than half (43.5%) of students spend 1-8 hours a week, while 38.0% spend 17 or more hours a week at work.

First, we were interested in the influences of work that students did on the time required for compulsory classes. Data show that a third (32.9%) of students think that their work is less time

consuming, and the same percentage (32.9%) of those students say that their work does not take the time allotted for teaching and learning. It is interesting to note that only 6.5% of respondents say that their time spent on learning and teaching is completely fulfilled by their engagement at work. At the same time, the number of students (44.4%) who attend 50 to 70% of classes and those (44.4%) who attend classes regularly, or more than 70% of attendance is the same. Only 3.2% of students attend classes rarely (up to 30% attendance). Accordingly, we also examined the potential impact of student work on students 'academic achievement. Half (51.9%) of the respondents state that their work do not affect their academic success, while slightly less than a quarter (23.5%) think that student work still affects their academic success and that they would certainly have better academic success if they do not work during their studies (20.4%).

Further analysis (chi-square test) reveals that there is a statistically significant difference between men and women regarding their views on the amount of time need to fulfill their academic obligations ($\chi 2=9.451$; df=2; p=0.009). More women (76.4%) than men (23.6%) agree with that. Thus, hypothesis (H4), which assumed that men felt they had less time to fulfill academic obligations than women, was rejected.

When it comes to the monthly income of the respondents, 61.6% of students have 200 euros and more per month, 62.5% of students earns half of their monthly income through SC, while the rest is given to them by their parents. However, a fifth (20.8%) of students receive most of their monthly income from their parents or scholarships, while 16.7% of those surveyed rely entirely on their own income. Here we were also interested in the average hourly rate of students' work. According to the data, half (51.4%) of the respondents have an average hourly rate of between 2.69 and 3.37 euros, which is also the minimum fee, while 43.1% of students per hour earn from 3.37 to 6.74 euros. Accordingly, we also examined satisfaction with the salary their employer pays them. Data show that more than a third (38.9%) of students are partially satisfied with the income they earn doing their student work. A little more than a quarter (27.8%) of students are still not satisfied with the average hourly rate, and the least are those respondents who are completely satisfied with the hourly rate (8.8%). Furthermore, we were interested in the (non)existence of gender differences, so for the purpose of testing hypothesis (H1), which assumed that there was no difference between men and women in terms of job satisfaction through SC, a chi-square test was performed. The results show that there is no statistically significant difference between the respondents with respect to gender ($\chi 2=7.292$; df=3; p=0.063), so this hypothesis is accepted.

Since our respondents are full-time students, it is assumed that employers should be able to change shifts and hours of work as well as part-time when hiring, so that they can comply with their college obligations, which include attending classes, taking exams as and exam preparation. But very often this is not possible in practice. Also, in the Republic of Croatia, too small a job offer is a big problem. For this reason, students are forced to do different jobs that are not connected to their profession, as shown by earlier research (e.g. [8], [5]). This is best illustrated by the data obtained according to which the most common problems that students face when looking for a student job are primarily inflexible working hours (36.1%), very poor job offers (31.5%), and underpaid earnings (31.5%). Considering earnings, we were also interested in students' opinions about the potential difference in the amount of income for men and women. A chi-square test is also made here to test the hypothesis (H3) that assumes that women feel they have higher monthly earnings than men. Although most respondents (80.6%) disagree with the above, further analysis nevertheless shows that there is a statistically significant difference between the two samples ($\chi 2=7.687$; df=2; p=0.021). Women (63.8%) to a greater extent than men (33.3%) support this opinion, so this hypothesis is accepted.

We also examined how satisfied students were with their employers. In line with previous findings (e.g. [5]) and in this survey, most respondents (57.9%) believe that employers use students as a workforce, while pointing out that students still have less workplace rights than other workers (47.7%). Here again, we examined gender differences since we assumed by hypothesis (H2) that there were no differences between men and women regarding student exploitation in student affairs. The chi-square test revealed that there was no statistically significant difference between the subjects with respect to gender ($\chi 2=4.706$; df=2; p=0.095), so this hypothesis was accepted.

Finally, we also explored the most important reasons for student employment. Data show that most (94.9%) students work through SC during full-time study due to unfavorable personal financial situation. However, it should be noted that the vast majority (85.2%) of students work to afford themselves modern technology gadgets (eg a new cell phone, laptop, camera…). Also, the possibility of buying new clothes and shoes motivates many students (83.8%), followed by social life (the possibility of going to clubs) 81.0% and going on trips (77.3%).

Table 1. Students' opinions about relation between working and learning

Statements	Disagrees		Neither agrees nor disagrees		Agrees		In total	
	f	%	f	%	F	%	F	%
One would have better academic success if one would not work while studying	63	29,2	109	50,5	44	20,4	216	100,0
Employers are using students as a workforce	9	4,2	82	38,0	125	57,9	216	100,0
Students have fewer rights than other workers	19	8,8	94	43,5	103	47,7	216	100,0

All this is in line with previous research (e.g. [5]) according to which lower incomes and spending on social and leisure activities are motivations to work during studies. The results of this research show that students have a pronounced consumerist mentality in the context of contemporary Croatian consumer society. However, it should be emphasized that as many as 75.0% of those surveyed work during their studies in order to gain new experiences and knowledge, which is especially important if they are able to find a job in the profession for which they are educated, and half (51.4%) of the respondents are motivated for employment during full-time study by interesting and instructive work.

Table 2. Motivation to work

Reasons	Disagrees		Neither agrees nor disagrees		Agrees		In total	
	f	%	f	%	F	%	F	%
Unfavourable financial situation	1	0,5	10	4,6	205	94,9	216	100,0
Gaining new experiences and knowledge	7	3,2	47	21,8	162	75,0	216	100,0
Making new acquaintances	17	7,9	68	31,5	131	60,6	216	100,0
Interesting and instructive work	21	9,7	84	38,9	111	51,4	216	100,0
Good pay	18	8,3	35	16,2	163	75,5	216	100,0
Going on trips	17	7,9	32	14,8	167	77,3	216	100,0
Cosmetics	15	6,9	50	23,1	151	69,9	216	100,0
Clothes, shoes	7	3,2	28	13,0	181	83,8	216	100,0
Modern technology (cell phone, laptop, camera)	11	5,1	21	9,7	184	85,2	216	100,0
Social life (going out to clubs)	10	4,6	31	14,4	175	81,0	216	100,0

4 CONCLUSIONS

Full-time students in the Republic of Croatia have right to be employmed through Student service centers, which keep records of the calculations and payments of their members' earnings. Those who are in the process of attending college usually do not work full-time but try to reconcile their academic duties with part-time work. When it comes to equal opportunities for young people, it can be said that young people have a negative image, because the feeling of unequal opportunities in the labor market leads to the inability to plan other personal activities. Also, high unemployment has a negative effect on their perception regarding possibility to succeed in society.

The paper explains the experiences of full-time students at the University of Split regarding their work during their studies and the problems they face. The results show that a third of students believe that their academic performance has not been affected by the work, and slightly less than half of them think that their attendance of classes while studying and working is average and regular. However, just under a quarter of students believe they would certainly have better academic success if they did not work during their studies. The students are partially satisfied with the salary paid by their employer and there is no difference between women and men in terms of job satisfaction through SC. Most of the surveyed students do not consider women to have higher monthly earnings than men. However, when

looking at gender differences, it has been shown that women believe that they have higher monthly earnings, but they also estimate that they have less time than men for academic work.

Furthermore, students earn half of their monthly income through SC and the rest is received from parents. Yet, one fifth of students receive most of their monthly income from a parent or scholarship, which leads us to a conclussion that even though they receive scholarships, they are still forced to be employed. The most important reasons for employment of students are unfavorable personal and financial situation, purchase of modern technology, opportunity to buy clothing and footwear, social life costs, travel costs, and finally an interesting and educational job as well as gaining new experiences and knowledge. It should be emphasized that as many as half of the students surveyed believe that employers use students as a workforce, but there is no difference in the attitudes of women and men in this respect.

Finally, from all this, we can be concluded that work is a regular occurrence in several countries during full-time study but until it does not affect studying. Also, each state is expected to participate in student funding and to regulate all types of jobs so as not to exploit cheap labor. Very rarely, student jobs can be considered as a space for learning their profession and practice in the workplace, that is, a space for performing student internships.Therefore, doing student work for most students is a source of income and a way to improve their own budget.

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Social development of children with disabilities in the integrated departments in Montenegro

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Abstract

Socialization is not just training an individual for social life and his future role in society, but it is very important for personality formation, which is formed through learning with certain characteristics, and thus becomes a member of one culture (1). Conflicts in the family, inconsistent discipline, affective cold, parents' hostility, poor monitoring and non-inclusion of parents in the everyday life of a minor, but also his psychological and emotional state, as well as crime and alcoholism in the family can be important factors, causers and triggers of the appearance of delinquent behaviour. The research was conducted for the duration of one school year, and it is represented by the central, southern and northern regions of Montenegro, in integrated departments at regular schools (PI Primary school 'Ilija Kisic' Herceg Novi, PI Primary school 'Vuk Karadzic' Berane, PI Primary school 'Dusan Korac' Bijelo Polje, PI Primary school 'Njegos' Kotor, PI Primary school 'Bosko Buha' Pljevlja, PI Primary school 'Olga Golovic' Niksic and PI Primary school 'Yugoslavia' Bar. Starting from the nature, essence and importance of the defined problem, the subject of our study is focused on the social development of children with disabilities, as well as on the influence of social development on the presence of problematic behaviour. The most significant results of this research, and we think that they have an impact on the social development of the child are: the fact that 23% of children grew up, lived and formed a socio-emotional status with their parent, who was not in the marital union of another child's parent. Parent's education: the most frequent is secondary school with 45.5%, and the number of parents with non-completed primary school is relatively high with 14.5%. A significant number of parents of children with disabilities are unemployed (fathers 26.4%, mothers 60.0%). We can conclude that economic characteristic can be very unfavourable for the functioning of the family. Our research shows that there are quarrels between 51.8% of parents. Regarding the presence of psychological violence against children with disabilities, we have concluded that in 14.5% of children there are indications of experiencing some form of psychological violence. The quarrel between parents, as a serious disorder in the social and overall development of children with disabilities, are expressed as a problem in the amount of 23.6% and there are indications that they reach up to 33.7%. So we can say that the presence of this problem is high. It is not negligible that 40% of children with disabilities have an inadequate relation towards teachers.

Keywords*:* Social development, children with disabilities, unadjusted behaviour

1 INTRODUCTION

The family directly influences the development of a child, i.e. a minor, his upbringing, a way of understanding life circumstances and human relationships, and influences on his actions in the future. Besides the individual characteristics of a child, factors that can lead to unadjusted behaviour are low intelligence, poor school achievement, poor empathy, aggression, hyperactivity and attention deficit and family factor. (2). Therefore, even when it comes to youth delinquency, risk factors and protective factors are reduced to four groups, i.e. family factors, school factors, community-based factors, and individual factors (3). The long-term effect of these factors can lead to the formation of negative attitudes, unfavourable self-image, ambivalence or destructive relation towards others. Children with disabilities may be less successful in overcoming developmental crises, in the process of transition from childhood to adolescence. Socialization is the process of learning through which the individual acquires socially relevant forms of behaviour and is formed as a person with all its characteristics (4). Social development is a process of learning how to live, and how to behave in the environment of others. These are changes that lead to new relationships with others, greater independence and responsibility. The period of transition from childhood to adolescence marks the redirection and assimilation of social values. Gradual attention moves from family to broader society, with increased

need for independence and responsibility. Therefore, adolescents still rely on the family, especially in terms of love, and security restrictions. Growing up in poverty is associated with many negative outcomes, firstly with health and unadjusted behaviours, and poorer school success and educational outcomes. The consequences are more serious if a child lives in extreme poverty, deprivation can leave long-term consequences. Particularly harmful is the experience of poverty in early childhood (5). Since poverty is a stigmatized position that parents and students talk about unwillingly, timely community support is often lacking. It is therefore important to know that late interventions can have positive results. It is recommended, in cooperation with the local community, to organize concrete financial assistance. Over time, in the study of the phenomenon of social development, the focus is moved from intrapersonal to interpersonal. The centre of interest is the interaction of a child with a family group and a peer group. The aim is to integrate the child's sequences of social interaction with his current cognitions and emotions. (6).

The results of a large number of studies show that the sociometric position of pupils with visual disturbances is significantly worse than the sociometric situation occupied by pupils without visual disturbance (7-10)state that students with visual disturbance (regardless of visual acuity) have a worse sociometric status than pupils without visual disturbances. More often they occupy a low, rarely high sociometric position in the classroom, compared to peers without visual disturbances. The authors explain that students with severe visual disturbances, even in 30% of cases, occupy a low sociometric status. If we know that visual disturbance is one of the least developed disturbances and we see the extent of non-acceptance by peers, then we can say with certainty that school factors are responsible for some unaccepted behaviour in children with disabilities. Intellectual difficulties, according to the latest definition of the American Association for Mental Retardation, are described by a significant limitation in overall intellectual functioning and in adaptive behaviour, expressed in conceptual, social and practical adaptive skills. They appear before the age of 18 depending on the interaction with the social environment. (11). Intellectual difficulties, according to the latest definition of the American Association for Mental Retardation, are described by a significant limitation in overall intellectual functioning, and in adaptive behaviour, expressed in conceptual, social and practical adaptive skills. Children with intellectual disabilities often go through a crisis during the first school years. Then they come to know that they are different, and that they may not be fully responsive to all social environments. Reactions to this cognition can be turned either inwardly (depression and feeling of worthlessness) or outside (aggression and motor disorder). Although undesirable forms of behaviour are common among people with intellectual disabilities, it is difficult to define them because they depend on the perception of people from the environment of these persons. Unaccepted behaviour is a major source of additional difficulties for children, young people and adults with intellectual disabilities. They represent additional suffering for both the individual and her parents, causing stress, which increases the likelihood of institutionalization, and reduced social integration and employment (12).conduct a research aimed at examining the frequency and characteristics of undesirable behaviour in children with intellectual disabilities, with a sample of 84 students, ages 7 to 14 years. Based on the conducted research, it was concluded that there is a significant difference in the frequency and characteristics of undesirable behavioural patterns in relation to gender, where boys showed a higher level of undesirable behaviour in relation to girls; in relation to age, where children with intellectual disabilities of the elderly have shown more undesirable behaviour in relation to children with intellectual disabilities of the younger age. The creator of the psychosocial theory, Erik Erikson (13) does not limit the development of childhood but considers it to be a process that extends throughout life. Cognitive social transition to the adult world leads to the nervous system matured, reaching formal operations, then overcoming child egocentrism on the cognitive and social plan, and social experience acquired in the family, school and peer group. In the research "Parents' attitudes towards children with behavioural disorders(14), the authors state that the problem of research is unaccepted behaviour in children and young people, and the role of parents in the prevention and rehabilitation of children with disorderly behaviour, in order to preventing the consequences for the education and development of children. The aim of the work was to examine and determine whether the attitudes of parents towards children with unaccepted behaviour were positive or negative. The sample of respondents consisted of 220 parents of eight-year students, nine-year elementary school. The results of the study showed that parents saw different forms of unadjusted behaviour in their children. Children begin to manifest unaccepted behaviour in different periods of their lives. Parents are difficulty communicating with children with unsuitable behaviour. Parents most often solve unaccompanied behaviour of the child with the help of experts (pedagogue, psychologist and social worker). Respondents had the view that children with unadjusted behaviour should be helped, and they also believe that children with unadjusted behaviour are not always adequately accepted by their peers. Cooperation between family and school is not always adequate when it comes to addressing the problem of children with unadjusted behaviour.

2 OBJECTIVES OF RESEARCHES

Objectives of researches are: 1. Identify the level of social development of children with disabilities, 2. Identify forms of behavioural disorders in children with disabilities, 3. Identify the impact of social characteristics of families on children with disabilities with problematic behaviour. **Sample:** Children attending integrated classes (seven classes) at regular schools PS "Olga Golovic" Niksic, PS "Bosko Buha" Pljevlja, PS "Njegos" Kotor, PS "Jugoslavija" Bar, PS „Ilija Kisic"-Zelenika, PS "Dusan Korac" Bijelo Polje and PS "Vuk Karadzic" Berane**. Instruments and test procedures:** The research will use the Diagnostic Protocol for the Study of Social Development and Behavioural Disorder. Data are obtained from the class elder and the social worker. **Basic data** (school, class, disorder - we take data from the routing solution, gender, age). **Family status** including the following indicators (marital origin, marital status, family structure, number of siblings). **Socio-economic characteristics of families** (educational background of parents, parents' interests, working status of parents, residential status of a family, material status, use of material benefits, family emigration). **Family health status, Deviant behaviour** (alcoholism, other deviant behaviours). **Family conflicts** (quarrels between parents, fights between parents). **Violence against children in the family** (physical violence, psychological, sexual). **Problems in the pedagogic-educational process** (general success, behaviour on the class, relationship of children to teachers, relationship of children towards peers, absence of children from school, cooperation of parents with school). **Risky and deviant behaviour** (socializing children with delinquent peers, aggressive behaviour of children, auto-aggressive behaviour of children, escaping children from school, escaping respondent from house, begging and vagrancy of children, committing violations and criminal offenses by children, misuse of psychoactive substances by children). In addition to this basic research tool, an open-unstructured interview method will be used.

3 RESULTS

Table 1. Distribution of children with disabilities according to the school they attend

School name	Children	
	No.	%
PS „Olga Golovic" Niksic	22	20.0
PS „BoskoBuha" Pljevlja	15	13.6
PS „Njegos" Kotor	8	7.3
PS „Jugoslavija" Bar	19	17.3
PS „IlijaKisic" Zelenika	22	20.0
PS „DušanKorac" BijeloPolje	5	4.5
PS „Vuk Karadzic" Berane	19	17.3
Total:	**110**	**100**

Table 2. Distribution of children with disabilities according to the class they attend

Class at school	Children	
	No.	%
I	12	10.9
II	15	13.6
III	15	13.6
IV	10	9.1
V	16	14.6
VI	8	7.3
VII	9	8.2
VIII	10	9.1
IX	15	13.6
Total:	**110**	**100**

Table 3. Distribution of children with disabilities according to primary disorder in development

Primary developmental disorder	Children	
	No.	%
Mental disability	94	85.5
Visual impairment	3	2.7
Hearing impairment	1	0.9
Physical disability	12	10.9
Total:	**110**	**100**

According to the primary developmental disorder, respondents are distributed as seen in four categories, of which the most dominant mental disability

Table 4. Distribution of children with disabilities by sex

Sex	Children	
	No.	
Male	76	Male
Female	34	Female
Total:	**110**	**Total**

Distribution of children with disabilities by sex, shows us that the boys are twice more than girls

Table 5. Distribution of children with disabilities by age

Age	Children	
	No.	
7-10	33	7-10
11-14	45	11-14
15-18	32	15-18
19-24		19-24
Total:	**110**	**Total**

The sample includes respondents from 7-18 years.

Table 6. Distribution of the survey population according to marital birth origin

Marital origin	No.	%
Marital born	90	81.9
Illegitimate recognized paternity	15	13.6
Illegitimate unrecognized paternity		
Illegitimate unknown paternity	1	0.9
Unknown parents	4	3.6
Total:	**110**	**100**

Most of our surveyed population comes from the marital community 81.9%, illegitimate community 13.6%, while unknown parents 3.6%.

Table 7. Marital status of parents of children with disabilities

Marital origin	No.	%
Married	84	76.4
Divorced	5	4.5
In a divorced dispute		
Longer absence of one of the parents	1	0.9
The death of one parent	2	1.8
They never lived together		
One parent unknown	1	0.9
Both parents are unknown	3	2.7
Dead parents		
Illegitimate community	13	11.8
Total:	**109**	**99.1**

Parents of the surveyed population of children with disabilities live in a marital community 76.4%. We identified the fact that 23% of children grew up, lived and formed a socio-emotional status with their parent, who were not in the marital community of another parent.

Table 8. Structure of the family of children with disabilities

Child lives with	No.	%
Both parents	92	83.6
Mother	6	5.5
Father	3	2.7
Tutor		
In the home for children without parental care	9	8.2
In extended family		
Total:	**110**	**100**

By analysing the data presented in Table 8, 83.6% of children live in a complete family, nuclear or expanded type, 8.2% in a home for children without parental care, with a mother 5.5%, and with father 2,7%.

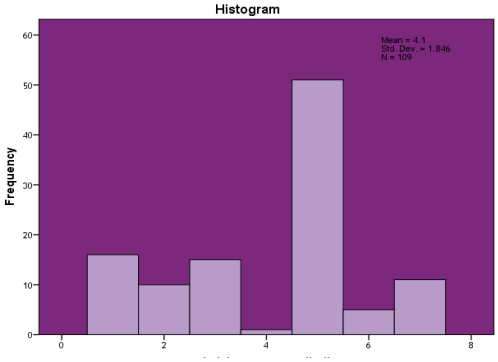
Table 9. Number of siblings (brothers and sisters) of children with disabilities

Number of siblings	No.	%
Only child	20	18.2
One brother/sister	45	40.9
Two and more brothers/sisters	45	40.9
Total:	**110**	**100**

The presented data show that most of the 40.9% examinees have one brother or sister. Also, 40.9% have two or more siblings. This practically means that 80.1% of children have one or two siblings.

Table 10. School education/educational level of parents of children with disabilities

Educational background of children's parents	Father		Mother	
	No.	%		No.
Unfinished PS	16	14.5	Unfinished PS	16
Finished PS	10	9.1	Finished PS	10
Qualified/Highly qualified	15	13.6	Qualified/Highly qualified	15
Special school	1	0.9	Special school	1
Secondary education	50	45.5	Secondary education	50
Higher education	5	4.5	Higher education	5
University education	11	10	University education	11
Master/Doctor			Master/Doctor	
Total:	**108**	**98.2**	**Total:**	**108**



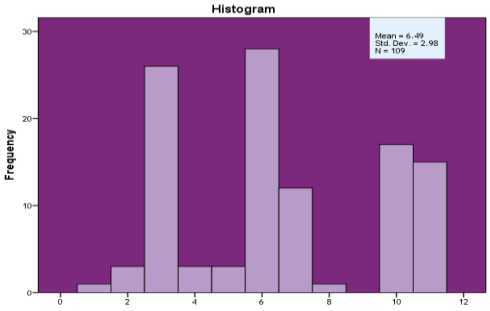
Degree of schooling of parents

According to the presented data, the fathers of the examined children have completed elementary school in 9.1%. The higher education rate is 10%, Qualified/Highly qualified is 13.6%, Secondary education is 45.5% and it is the most frequent, the relatively high is the number of parents with unfinished primary school and it is 14.5%.

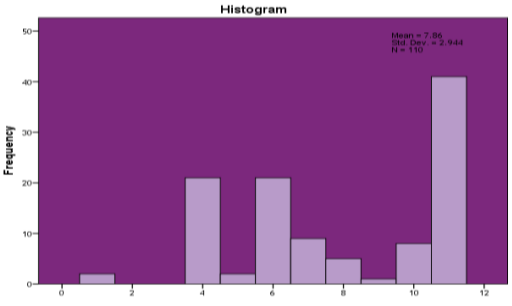
Similar to the previous one is the distribution of the educational level of mothers of disabled children. Finished Secondary school with 44.5% is the most frequent.

Table 11. Interest of parents of children with disabilities

The interest of parents of children with disabilities	Father		Mother	
	No.	%	No.	%
Industry / Mining	1	0.9	2	1.8
Agriculture / Forestry	3	2.7		
Construction	25	22.7		
Commerce	3	2.7	21	19.1
Finance / technical and business services	3	2.7	2	1.8
Catering / Craft	28	25.5	21	19.1
Housing/communal services	12	10.9	9	8.2
Education, science, culture, information	1	0.9	5	4.5
Health, social welfare			1	0.9
State authorities	17	15.5	8	7.3
Without interest	15	13.6	41	37.3
Total:	**109**	**99.1**	**110**	**100**



Profession of parents-father



Profession of parents-mother

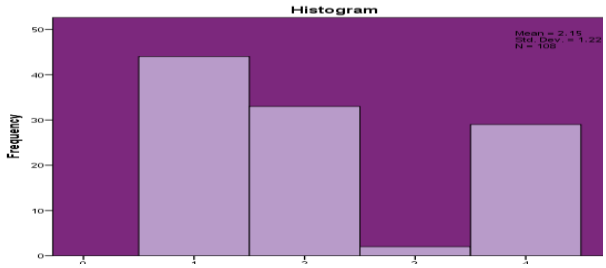
The number of parents of children with disabilities without a certain occupation is relatively high, fathers 13.6%, mothers 33.3%. It can be right to say that this socio-economic benefit can be very

favorably reflected in the performance of family functions, especially economic and pedagogical-educational.

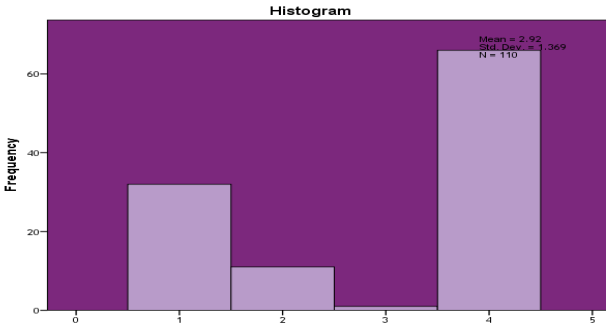
Table 12. Working status of parents of children with disabilities

Working status of parents	Father		Mother	
	No.	%	No.	%
On indefinitely	44	40.0	32	29.1
On certain	33	30.0	11	10.0
Pensioner	3	1.8	1	0.9
Unemployed	29	26.4	66	60.0
Total:	**109**	**98.2**	**110**	**100**

Parents of the surveyed population are employed indefinitely (40.0% of fathers and 29.1% of mothers). A significant number of parents of children with disabilities are unemployed (fathers Employment status of parents-mother and father 26.4%, mothers 60.0%). We can conclude that economic characteristics can be very unfavourable for the functioning of the family.



Working status of parents - father



Working status of parents - mother

Table 13. Housing status of families of children with disabilities

Housing status	No.	%
Subtenants	37	33.6
Owners of apartments/house	63	57.3
Necessary accommodation / illegal	10	9.1
Total:	**110**	**100**

The housing situation in the family of children with disabilities is relatively poor, with subtenants and necessary accommodation 43.0%.

Table 14. Material status of families of children with disabilities

Material status	No.	%
Favorable	12	10.9
Average	47	42.7
Unfavorable	51	46.4
Total:	**110**	**100**

The situation regarding the material status of families of children with disabilities is significantly unfavourable.

Table 15. Use of material benefits

Using of benefits	No.	%
Increased child allowance	35	31.8
Child allowance	27	24.5
Material support	32	29.1
Allowance for care and assistance	58	52.7
Personal disability	63	57.3
Total:	**215**	**195.4**

Because of a better and more realistic view of the overall economic status of the families of the surveyed population, data on the use of various types of material benefits were collected and processed. Families use some form of prestige, and most of all, care and assistance allowance (52.7%) and personal disability allowance (57.3%). Families are in a bad financial situation, i.e. in a state of social need.

Table 16. Emigration of families of children with disabilities

Emigration	No.	%
Refugees	2	1.8
Not refugees	108	98.2
Total:	**110**	**100**

Children with disabilities tolerate on more difficult way change in the environment. Traumas and stresses that are resulted from these events surely leave visible consequences at all levels of their functioning. Our research shows that there are only two families of refugee status.

Table 17. Health status of family members of children with disabilities

Health status	Father		Mother		Brother		Sister	
	No.	%	No.	%	No.	%	No.	%
Without health problems	88	80.0	90	81.8	66	98.5	65	100
Organic chronic disease	16	14.6	14	12.7				
Mental illness	2	1.8	4	3.6				
Disability	3	2.7	2	1.8	1	1.1		
Total:	109	100	110	100	67	100	65	100

Brothers and sisters of children with disabilities have a small number of health problems, while parents have more health problems.

Table 19. Other deviant behaviour of family members of children with disabilities, and jail punishment research,

Deviant behavior	Narcotism		Criminality		Prostitution		Jail punishment	
	No.	%	No.	%	No.	%	No.	%
There is no problem	110	100	110	100	110	100	110	100
There is a problem								
There are clues								
Total:	110	100	110	100	110	100	110	100

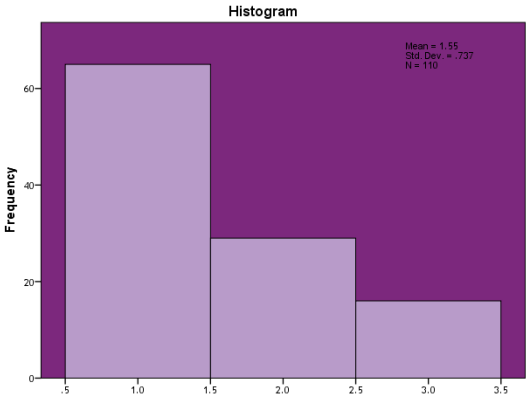
These data deserve an additional comment. In this research, we were faced with an objective methodological limitation, that is to get family data from teachers of the integrated classes, bearing in mind the parents' unwillingness to respond honestly the offered questions.

Table 20. Quarrels between parents of children with disabilities

Quarrels	**No.**	**%**
There is no problem	46	41.8
There is a problem	57	51.8
There are clues	7	6.4
Total:	**110**	**100**

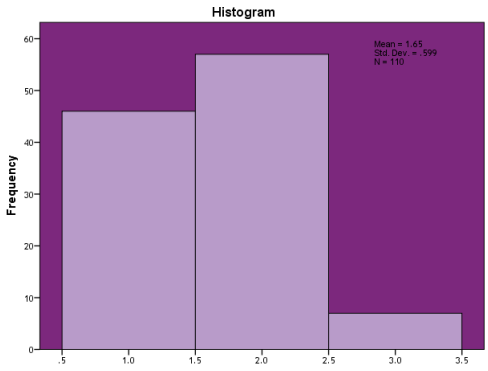
Table 18. Alcoholism in the family of children with disabilities

Alcoholism	**No.**	**%**
There is no problem	65	59.1
There is a problem	29	26.4
There are clues	16	14.5
Total:	**110**	**100**



Alcoholism in the family

According to the data, in almost 40% there is a problem and indications of alcoholism in the families of children with disabilities

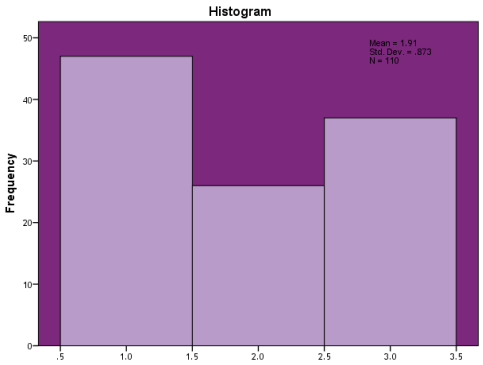


Quarrels between parents

Chronic family conflicts, primarily expressed through the presence of quarrels and fights between parents, are an important factor in the social development of children with disabilities. More specifically, family conflicts constitute a significant risk factor for the emergence of various forms of psychosomatic and behavioural disorders in this particularly vulnerable group of children. The quarrels between parents are included in this research in a form of disrupted relationships, which have elements of psychological violence (and are often only a prelude to physical violence between partners/parents), and therefore we place this phenomenon in a broader whole, in which we present the presence of violence in the families of children with disabilities.

Table 21. Fights between parents of children with disabilities

Fights	Number	%
There is no problem	47	42.7
There is problem	26	23.6
There are clues	37	33.7
Total:	**110**	**100**

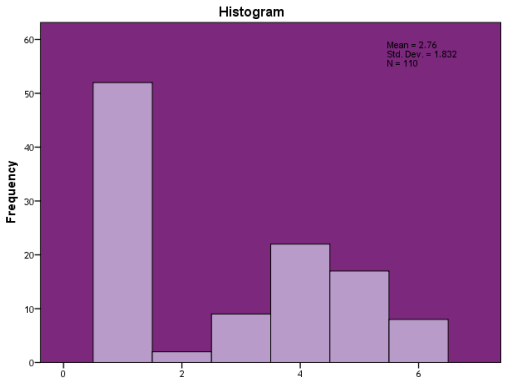


Fights

Fights between parents, as a serious disorder in the social and overall development of children with disabilities, is expressed as a problem of 23.6% and there are clues of 33.7%. So, we can say that the presence of this problem is high. In terms of partner relationships, researches show that spouses from these families have incomparably weaker harmony, compared to partners who do not have a child with disabilities. Poor harmony, which is usually the cause of partner conflicts, is most often due to the distribution of housework, child upbringing, leisure time, disturbed communications (15).

Table 22. Neglecting children with disabilities

Neglecting	No.	%
It does not exist	52	47.2
Underfed	2	1.8
Inadeq. clothing and footwear	9	8.2
Hygienic neglected	22	20.0
Inadeq. health care	17	15.5
Multiple neglected	8	7.3
Total:	**110**	**100**



Neglect of children

A key observation is that 47% of children with disabilities experience some form of neglect. The most present is hygienic neglect 20% and inadequate health care 15.5%.

Table 23. Physical violence against children with disabilities in the family

Physical violence	No.	%
There is no problem	87	79.1
There is a problem	5	4.5
There are clues	18	16.4
Total:	**110**	**100**

In this study, under the general concept of violence against a child with disabilities, it means 'such relationships and behaviours of individuals of social groups, whom with the use of force, inflicts pain, physical and mental damages, endanger the health and physical and psychological integrity of the personality, and prevent the normal development of a child with disabilities.' (16)

Table 24. Psychical violence against children with disabilities in the family

Psychical violence	No.	%
There is no problem	94	85.5
There is a problem		
There are clues	16	14.5
Total:	**110**	**100**

According to the presence of psychological violence against children with disabilities, we have concluded that in 14.5% of children exist signs of experiencing some form of psychological violence. The experts, who gave us answers in just over 85% of cases, are sure that these children have not had negative experiences of psychological abuse in their families.

Table 25. Sexual violence against children with disabilities in the family

Sexual violence	No.	%
There is no problem	110	100
There is problem		
There are clues		
Total:	**110**	**100**

The results show that there was no sexual violence against children with disabilities.

Table 26. General school success of children

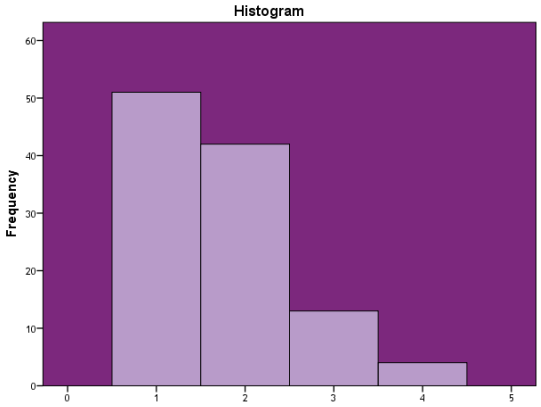
School success	No.	%
Excellent	19	17.3
Very good	26	23.6
Good	49	44.5
Satisfying	9	8.2
Bad marks	1	0.9
Repeat the class		
The first class	6	5.5
Total:	**110**	**100**

According to the data presented in Table 26., children with disabilities had excellent success in 17.3% of cases, 23.6% of cases were very good, 44.5% were good, 8.2% were satisfying, only one pupil was behaviour of children on the class failing, while there were no pupils who repeated the class.

Table 27. Behaviour of children with disabilities on the class

Behaviour of children on the class	Children	
	No.	%
Adequately	51	46.4
Restless, Careless	42	38.2
Recluse, timid	13	11.8
Frightened, sensitive	4	3.6
Total:	**110**	**100**

Teachers evaluate the behaviour of children on the class as adequate in 46.4% of cases. In other cases, it is not evaluated as adequate.

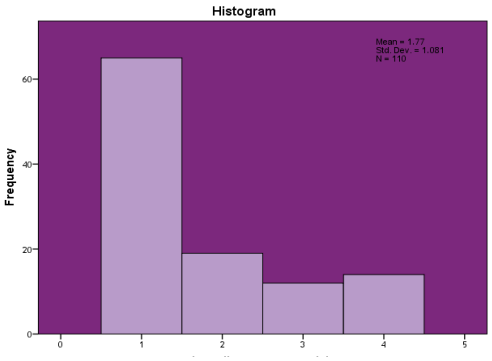


Behavior of children with disabilities on the class

Table 28. The relation of children with disabilities to teachers

The relation of children to teachers	Children	
	No.	No.
Adequately	65	59.1
Excessive relation	19	17.3
Spite, disobedience	12	10.9
Open aggression	14	12.7
Total:	**110**	**100**

Table 28. shows data about the relation of children from the Integrated classes to teachers. In most cases, 59.1%, this relation is evaluated as adequate for teachers. It is not negligible data that 40% of children with disabilities have an inadequate relation towards teachers.



The relationship of children with

Table 29. The relation of children with disabilities towards their peers

Description of relation towards peers	Children	
	No.	%
Popular, favourite	9	8.2
Accepted	88	80.0

Table 30. The absence of children with disabilities from the school

The absence of children from the school	Children	
	No.	%
No absences	36	32.7
Many justified absences	71	64.4

Isolated, unaccepted	13	11.8
Total:	**110**	**100**

With the largest number of tested children, the relation towards peers was rated as adequate 80.0%, popular and favourite 8.2%, while 11.8% isolated and unnoticed.

Table 31. Cooperation of parents with school

Evaluation of cooperation	Examinees	
	No.	%
Good cooperation	83	75.5
Occasional contacts	22	20.0
Disinterest	5	4.5
Total:	**110**	**100**

Cooperation with parents is on an enviable level, and the assumption is that the development of the IDEP, which is legally supported, has caused such a high level of cooperation.

Table 33. Aggressive behaviour of children with disabilities

Forms of aggressive behaviour	Children	
	No.	%
No exist	68	61.8
Physically attacks on others	23	20.9
Verbal attacks on others	9	8.2
They destroy school property	6	5.5
All mentioned forms	4	3.6
Total:	**110**	**100**

Table 34. Aggressive behaviour of children with disabilities

Forms of auto aggressive behaviour	Children	
	No.	%
No exist	83	75.5
Self-harm	27	24.5
Suicide attempt		
Total:	**110**	**100**

Table 34. shows that a significant number of children with disabilities with auto-aggression type is 24.5%.

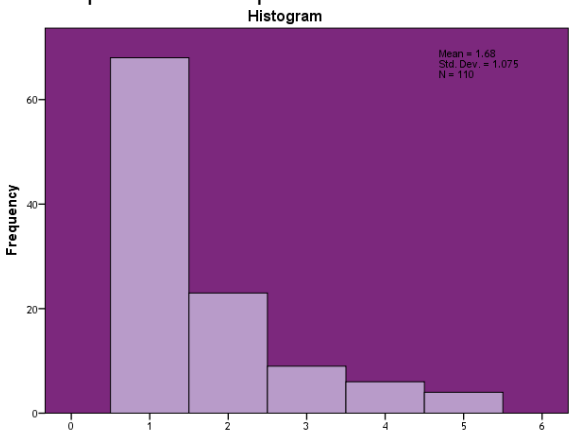
Many unjustified absences	1	0.9
Often late in school	2	1.8
Total:	**110**	**100**

Table 30. shows data about the absence from the *school.* Children in the Integrated classes children with disabilities, so that their large number of justified 64.4% of absences has just connected with their state.

Table 32. Socializing children with disabilities with delinquent peers

The existence of delinquent bonds	Children	
	No.	%
No exist	108	98.2
Occasionally connected	2	1.8
Member of the delinquent group		
Total:	**110**	**100**

With many children with disabilities, teachers, dialectologists, psychologists, social workers, have not detected the existence of a link between children from the Integrated classes with the peers of delinquent behaviour.



Forms of aggressive behavior

The research found that in 39% of children with disabilities there is some form of aggressive behaviour.

Table 35. Escaping children with disabilities from the school

Escaping from the school	Children	
	No.	%
Not present	108	98.2
Periodically	2	1.8
Frequently		
Total:	**110**	**100**

Based on the data presented in Table 35., we can conclude that a small number of children with disabilities, 1.8%, escapes from classes.

Table 36. Escaping respondents from home

Escaping from the home	Children	
	No.	%
Not present	106	96.4
Periodically	3	2.7
Frequently	1	0.9
Total:	**110**	**100**

Occasionally and frequently escape of children with disabilities was detected in 3.6% of children

Table 37. Begging and vagrancy of children with disabilities

Begging and vagrancy	Children	
	No.	%
Not present	**108**	**98.2**
Periodically	**1**	**0.9**
Frequently	**1**	**0.9**
Total:	**110**	

Occasionally and frequently begging and vagrancy were detected in 1.8% of children of the Integrated classes.

Table 38. Thefts in the school by children with disabilities

Thefts in the school	Children	
	No.	%
Not present	109	99.1
Periodically	1	0.9
Frequently		
Total:	**110**	**100**

Table 39. Commission of delicts and criminal offenses by children with disabilities

Commission of delicts and criminal	Children	
	No.	%
No exist	109	99.1
It exists	1	0.9
Total:	**110**	**100**

Theft and the commission of delicts, as well as the criminal offenses of children with disabilities, is only represented in two children.

Table 40. Abuse of psychoactive substances in children

Abuse of psychoactive substances in children	Smoking		Alcohol		Drugs	
	Children	%	Children		Children	%
Not present	107	97.3	110	Not present	107	97.3
Present	1	0.9		Present	1	0.9
There are clues	2	1.8		There are lies	2	1.8
Total:	**110**	**100**	**110**	**Total:**	**110**	**100**

It was detected that only one student uses cigarettes, while there are indications for two more children. With regard to alcohol and drugs, teachers, professional associates and defectologists said that it was not present in children with disabilities.

4 CONCLUSION

Bearing in mind the growing tendency to include children with disabilities in the regular school, then the possible negative consequences of peer rejection, it is necessary to act proactively, and in the school practice include strategies that can contribute to the improvement of peer relationships among children, good peer relationships positively influence on the development of social skills, and that behaviour becomes more social and more flexible(10).

The obtained results are largely confirmed by the current foreign and domestic research, and point to the need for wider social engagement, aimed at building a social model with emphasis on support to families of children with intellectual disabilities from the earliest age, which would enhance emotional and social development, through intervention in stimulating environment. Parents are very important partner in assessing and creating and implementing an intervention. Undesirable behaviour reduces the possibility of learning a child with intellectual disabilities and their participation in everyday family life, and it is necessary to educate parents with strategies to remove unwanted behaviours, and more importantly, to implement programs to foster the development of communication and social skills.

This scientific consideration of the problem indicates that it is necessary to encourage all competent institutions, services and individuals to work together in a harmonized manner, in order that all social potentials be professionally, responsibly and rationally used in recording, monitoring, controlling, correcting and preventing unacceptable behaviour of children and young people.

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Part V - THE POWER OF THE ECOSYSTEM

Urban Forestry as Part of Green Cities: The Evidence from Research and Academy Areas

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Abstract

Currently there are more than 7 billion people living on Earth. In 2016, there were 512 cities with at least 1 million inhabitants globally. That means that the pressure on natural resources is increasing every day, especially because starting from 2008, share of urban population exceeds fifty percent. In order to improve the quality of life for city inhabitants and coming generations, cities are to become greener. Hence, the concept of urban forestry can be considered a part of sustainable green economy and green cities. Education and science are very important for sustainable development of urban forests. The paper investigates activities of educational and scientific organizations in the field of urban forests.

Keywords: green city, sustainability, forestry, urban forestry, research area, academy area.

1 INTRODUCTION

Generally, if we consider urban forestry to be a concept for urban living, it can play an essential role due to the fact that trees can cool air in urban areas, regulate water flow, absorb up to 150 kg of CO_2 per year, and affect mental and physical health of the population, especially children. Trees also increase urban biodiversity, and property value due to landscaping. At the same time, woods and trees have personal, local, community and cultural meanings, and are therefore important for the population [19]. Urban forests, as well as community Gardens, contribute to "psychosocial resilience after a disaster" [16] and walks in the forest help "enhance positive emotions [16]. Urban forestry, according to the Oxford dictionary, is “the science or practice of planting, managing, and caring for forests” [9] or “the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits trees provide society (Helms, 1998). Community Gardens are reviewed by "as an important place to distress, share experiences, and gain community support" [17]. According to Gerhold [13], origins of urban forestry date back to 1792 when in Philadelphia, USA, citizens required having public trees planted, and in 1896, the city hired its first arborist as the Chief Forester.

In 1974 Professor Erik Jorgensen defined the term urban forestry as "a specialized branch of forestry that has in its objectives the cultivation and management of trees for their present and potential contribution to the physiological, sociological and economic well-being of urban society” (Jorgensen, 1974). Many researchers treat urban forests as a facility for the resistance of urban social–ecological systems and as objects for maintaining urban food security [4]. But although urban forests are recognized as essential for cities, generally, they are vulnerable because, according to Alberti et al. [1, 2], urban forests are affected by the environment which is constantly changing. Also, some scientists are sure that “the spatial distribution of urban greenness within a city is largely influenced by land use configuration and social factors” [10]. Though urban forests are recognized as essential for cities, they are generally vulnerable, because, according to Alberti et al. [2], urban forests are affected by the constantly changing environment. Preferences of the respondents increased along with increasing tree biodiversity levels in parks and wastelands, and the most diverse streetscape scene also received the highest mean rating [11]. In addition, urban forests "encourage social interaction and bonding such as central meeting and lunch places and communal working areas" [6]. So, research and academic areas investigate the modern problems of urban forestry together with the problems of green cities and sustainable development (Fig.1).

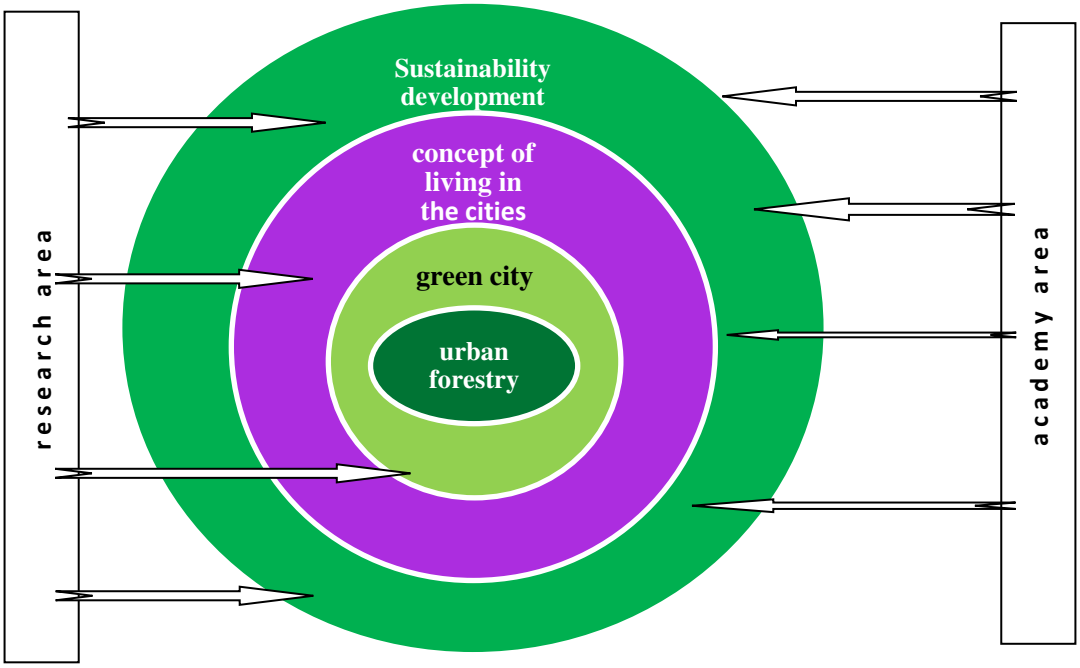

Fig.1.- Urban Forestry as a Part of Green Cities

Source: Authors

2 METHODOLOGY

2.1 Methods

The study is based on the method of bibliographic analysis of materials on the study and analysis of urban forestry, available in the scientific literature, as well as data on educational programs urban forestry, forestry, green city from the official websites of universities. The study uses a methodological approach that allows generating a conceptual model of the prevalence of urban forestry ideas in scientific research based on the selection of specific requirements from the organizational descriptions of bibliographic sources by keywords. As keywords, the words "urban forestry", "rainforest", "plantation", "bush" was used. The keyword "community Gardens" was not used in the research process because the peculiarities of growing urban forests and community Gardens are different. Based on statistical analysis of bibliographic sources in this article, a model of ranking of countries and universities by the criterion of the number of published scientific papers on urban forestry. The graphical method is used to display the results of statistical analysis of urban forestry universities localization in all major regions of the world: Northern America, Eurasia, Australia, Africa, and South America. Data from 563 urban forestry universities were used for analysis and graphical interpretation. The use of the graphical method allowed assessing the level of perception of the importance of urban forests for the human environment and the level of satisfaction of the population in urban forestry, through the number and concentration of urban forestry universities.

2.2 Data collection and analysis

The total number of analysed sources is 114,580 scientific publications. The statistical distribution of scientific articles on databases of citations and keywords are given in table 1.

Table 1. - Statistical database on scientific publications published in the period 1990-2017 retrieve from Scopus data base and WoS data base.

Keywords	Number of articles retrieve from Scopus data base	Number of articles retrieved from WoS data base	Total of the keywords
"urban forestry"	3 916	1135	5051
"rainforest"	10 708	13 284	23 992
"plantation"	30 756	30 898	61 654
"bush"	13 269	10614	23 883
Total of the data base	58 649	55 931	114 580

Source: Authors

3 ANALYSIS OF SCIENTIFIC PUBLICATIONS RELATED TO FORESTRY

The purpose of the paper is to analyse the number of publications for this application area for the period between 1990 and 2017; the type of documents referring to urban forestry, and select countries or regions involved in urban forestry research, and key urban forestry research institutions based on the number of publications. Authors used Scopus and Web of Sciences databases as a search engine. The issue the authors focus upon is the degree of urban forestry representation in discourse of scientific research. The history of European education in the fields of forestry and urban forestry is very long: Forestry Universities exists in all countries, and their history often exceeds two hundred years. Almost any European country has its own Forestry University, supplemented with urban forestry courses. Green economy is the basis of sustainable development. Forestry and especially urban forestry have an important part in green economy and balanced environment management. Importance of urban forestry also increases considering the global trend for urbanization. Science is very important for the development of urban cities because now ecological situation in the cities becomes more and more complicated.

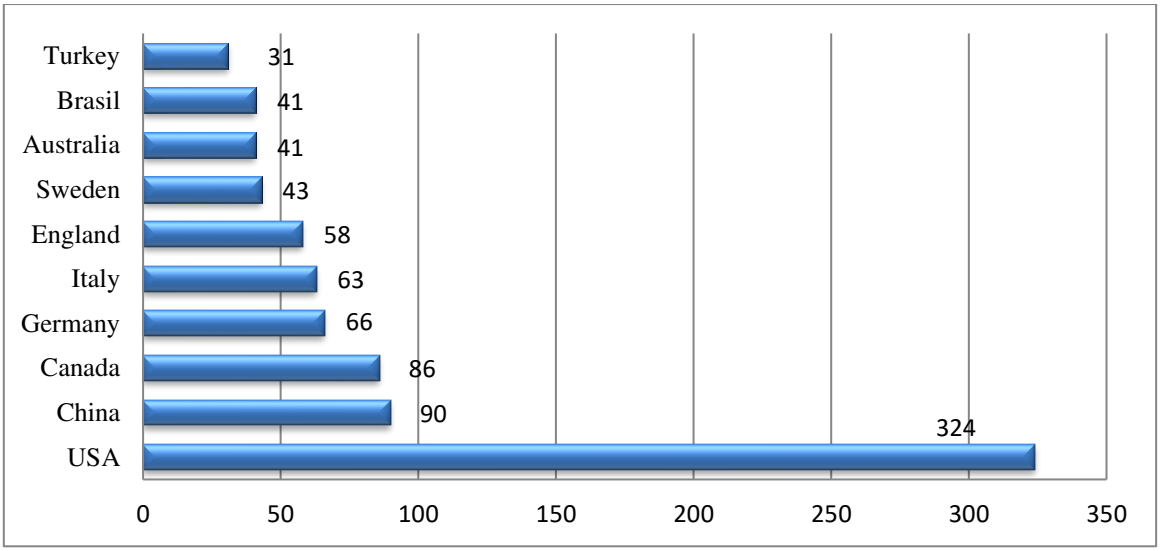

Fig. 2.- Urban forestry documents published around the World - top 10.
Source: Authors (2018) by Web of science Platform

Scientist research the ways of settling and preventing ecological problems in urban forests. The world leaders judging by the number of documents published globally according to Web of science data are

USA, China and Canada (Fig.1.). All these countries have large forest recourses (http://www.fao.org/home/en/).

World top rating by the number of documents devoted to Urban Forestry by Affiliation includes mostly universities (Fig.2). That demonstrates that academic society plays an important role in the development of urban forests.

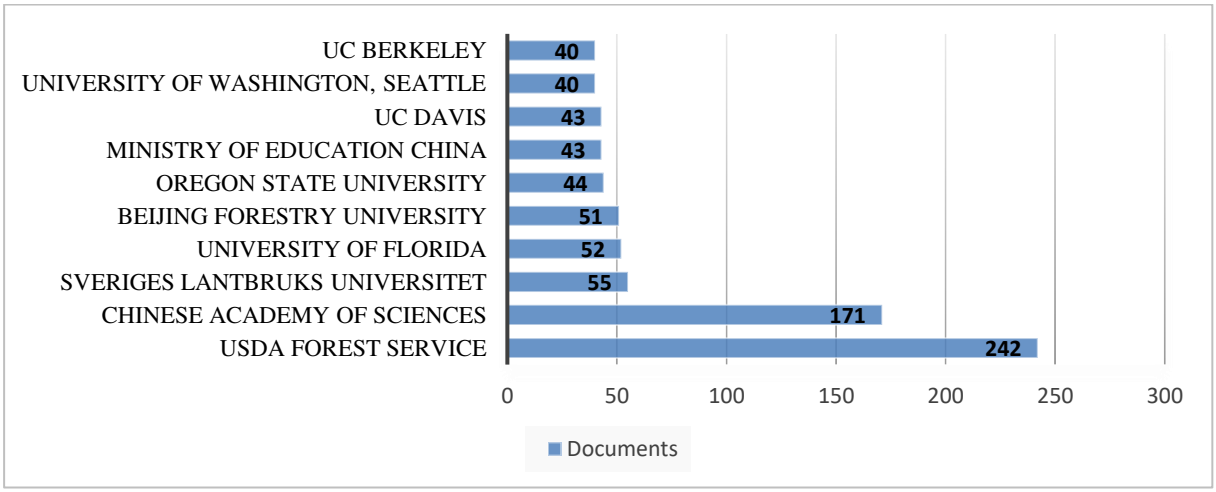

Fig. 3.- Number of documents in Urban Forestry by Affiliation– top 10.
Source: Authors (2018) by Web of science Platform

4 URBAN FORESTRY & EDUCATION

Usually all universities specializing in forestry have courses in urban forestry, gardening or landscaping because all this fields are very closely connected. Geography of urban forestry in the world is very extensive and it is possible to find schools providing education at different levels of urban forestry. These schools are in EU, Russia, America and Asia. Europe has a very long history of forestry and urban forestry. There is some professional association in these fields, but the most famous is the Conference of Deans and Directors of European Forestry Faculties and Schools. One can see that every European country has at least one forestry university, and courses in urban forestry especially related to landscaping. Urban forestry also has a long tradition in North America. The roots of urban forestry education reach back to 1907, when private companies started commercialization of urban forestry education [18]. According to [15], in the late 1960s and early 1970s forestry schools in the United States stared offering specialized urban forestry courses. A survey conducted in 1975 demonstrated that at that time Arboriculture programs were offered by 29 universities in the United States [17]. At that early stage, urban forestry programs already had developed curricula, options, specializations or tracks based on interdisciplinary support from other university departments, such as Regional and Urban Planning, Landscape Design, Business, Sociology, and the Humanities. A survey taken in 1990 demonstrated that 30 universities provided one or more undergraduate courses in this field [18].

5 RESULTS AND DISCUSSION

Figure 1 demonstrates the global top-10 of the countries having universities that specialize in forestry and urban forestry according to the number of papers published on these topics. The leading country in this regard is the United States. However, there is an interesting point - in terms of educational institutions number United States are immediately followed by Indonesia, India, and Brazil.

All of these countries are rich in forest recourses, and forests are important for their economies. Such a misbalance between the countries ranking by the number of publications and by the number of educational organization means that only USA is outside of the main trend when a country is a world leader in science and education in urban forestry, and at the same moment it is a country with developed economy. Other cases would need extended analysis. The concentration of forestry universities in the world shows that USA and Europe have big concentration of forestry universities. And it's confirmed by number analysis.

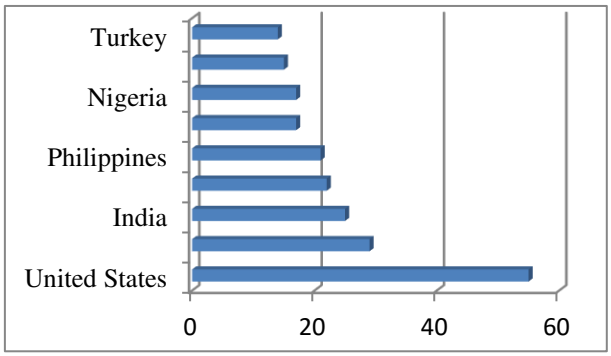

Fig.4.- Urban forestry universities around the World - top 10 countries
Source: Google Maps

6 CONCLUSION

The research of publications and the number of academic institutions demonstrates that the groups of top countries in the fields of science and education are different, except for USA, a global leader in urban forestry. Our conclusions correlate with world ranking of green countries including New York. Dual Citizen LLC came out with the 4th edition of the Global Green Economy Index, an in-depth look at how 60 countries and 70 cities are doing in developing more environmentally friendly economies, in terms of actual performance and in the way, experts perceive their performance. New York took the 7th place in this ranking (*Source*: https://www.ecowatch.com/top-10-greenest-cities-in-the-world-1881963132.html). Other countries from the top list of leaders in education and science need special case analysis and we will investigate it in the next articles. We supposed that such countries as China, Canada and Germany soon will improve their positions in world ranking in urban forestry education because their current scientific results create good basement for the development of educational programs. And our forecast about future of urban forest education is correlated with many global forecasts of global leading academic centres [1, 20].

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PART VI - GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT

Theoretical and Methodological Basis of Economic Dynamics as a Reflection of the Interaction of Economic, Social and Ecological Systems

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Abstract

An important scientific problem is the assessment of the interaction of economic, social and ecological components in the former social ecological and economic systems, the identification of patterns of their cross impact and the definition on this basis of options for projection of socioeconomic development with the preservation of the natural environment. The article analyses the improvement of modelling processes on the formation of optimal socioecological and economic systems in order to reduce the negative impact of substantive production on the human habitat. It also marks the influence of changes in some variables on the change in the others in the process of complex systems formation.

Keywords: economic dynamics, model, economy, environment, system, substantive production, variables, world system, global crisis.

1 INTRODUCTION

Economic dynamics is determined by the specificity of social development as a reflection of the processes of continuous circulation of correlated and interdependent transformation in the economic, social and natural systems, which determine, by internal and external forces, the formation, evolutionary development, crises and collapse of socioeconomic structures. The association of incessant and diverse qualitative and quantitative transformation of the elements in the socioeconomic system, the irreversibility of this process is determined by the continuous nature of evolutionary development, the consistency of the development of industries and sectors of the economy, section of public life, the optimal state of the organization of the public life in general. In this regard, one of the main problems of economic dynamics is the problem of the equipoise, proportionality and balance of the elements of social life, which ensure the sustainable socioeconomic development.

The research of the theoretical prerequisites for creating conditions for this balance encourages scientists, analysts and practitioners to create its perfect model. But taking into consideration that it is based on many economic, social, political, environmental and other factors, the dynamics and patterns of these changes, the formation of dynamic equilibrium and its multiple nature, the alternation of phases of cyclical development, as well as other significant problems of socio-economic development, this purpose is extremely difficult. The complexity of this problem is increasing due to the acceleration of the dynamics of social production and the raising importance of the two main trends. First, there is not only quantitative and qualitative exhaustion of sources of natural resources that forms the material basis of modern production, but also fauna and flora reduced in consequence of the human activity, significantly reducing the ability of environmental systems to restore, maintain their sustainable functioning and ensure favourable conditions for human development. Second, the pollution of the environment by industrial and household waste hampers the natural processes in the environment and requires the involvement of an increasing amount of resources for the active processing.

In this regard, it is important to highlight in the formation of the optimal socio-ecological and economic system such an important direction as improving the efficiency of the natural resource base on the exploitation of secondary resources. Capitalization of secondary resources contributes not only to a significant reduction of the negative impact of industrial and household waste on the environment, but also to a more harmonious combination of social, economic and environmental interests.

Close interrelation of active economic activity of the person and more accurate understanding of its dependence on a condition of the environment also induces many researchers to consider this dependence in its integrity and systematicity as union socioecological and economic system.

2 THEORY

Until the middle of the twentieth century the researching problem was considered under the prism of the limited natural resources in the interaction of ecology and economy, considering the significant increase in economic dynamics. In this connection, the negative effects of economic activity on the human environment from the point of view of the decline in both the quality of labour resources and the quality of life did not attract the proper attention of economic science. This is explained by the corresponding proportion of unlimited economic growth, low level of productive forces, high level of self-regulation of the biosphere, ensuring the sustainability of the ecological system [3].

The relative ability of the ecological system to self-recovery are reduced with the growth of technical weapons of the economy, the provision of significant anthropogenic impact. The transformation of the biosphere is formed based on its wider transformation into technical and man-made objects in order to better satisfaction of the socio-economic requirements [1]. Nature in a great extent becomes an object of intensive transformative activity. The idea of nature transformation to an increasing extent wins public opinion and forms a man-made type of economic development [4]. The transition to this type of development, characterized not only by the high rates of economic dynamics, but also the appropriate increase in environmental pollution, negative impact on the environment. These processes have found detailed coverage in the study of employees of the Massachusetts Institute of technology and other scientific institutions of the United States: Meadows D. G., Meadows D. L., J. Rynders., Behrens V. "Limits to growth", presented as a report on the project of the club of Rome "the Difficult situation of mankind» [5]. The main model of the study was developed considering the doubling of initial stocks and even their increase to unlimited, birth control, intensification of agriculture and favourable indicators of other variables. It identified the need for zero economic dynamics to prevent the growth of the negative impact of economic activity on the environmental system.

In the study of M. Mesarovich and E. Pestel, presented in the form of a report to the club of Rome in 1974, the main cause of the ecological crisis is determined based on a significant gap in the economic dynamics between developed and underdeveloped countries. The development options considered in the model to overcome the crisis "Organic growth" are based on the reduction and overcoming of this gap through significant additional investment in the economy of underdeveloped countries [6].

The gradual evolution of views in the formation of models that closely link economic dynamics with environmental protection is the gradual strengthening of environmental protection measures in the process of economic development. There is a gradual transition from the minimum economic costs in the first stage in the 60-70s to the prevention of pollution in the second, and a harmonious combination of maintaining economic dynamics with the preservation of the environmental environment. In 1992, the UN Conference on the environment "Agenda 21" formulates sustainable development at the end of the XX - beginning of the XXI centuries as a combination of meeting the needs of the current generation without compromising the needs of future generations. In 2012, the UN Conference on sustainable development "RIO + 20", stated that the global environmental crisis is aggravated, and practical measures are not clearly enough, despite the well-developed strategic course.

In 1972, V. V. Leontiev and D. Ford developed the first interindustry model, which closely linked the natural and material factors of the economic system, their industry affiliation, taking into account interindustry relations and cost ratios, with the corresponding structure of the negative impact on the environment [2].

With the name of John. Forrester linked the theoretical momentum that led to an increasing stream of research under the title “global modelling”. Based on the study of the interrelated unity of the world processes as a single system of industrial and agricultural production, social processes and environmental change, it is concluded that the further development of the current trends in the world system, is fraught with the inevitability of the global crisis. The basis of the upcoming crisis, according to the author, will be a contradiction between the limited natural resources of social production, the increasing needs in its volumes and the increasing processes of environmental pollution. The intensification of this contradiction will lead to the depletion of natural resources, decline in production and mortality increase. In this connection, there is an objective need to stabilize industrial production and material consumption. Therefore, it is extremely important for humanity to understand the content and nature of the interaction of subsystems that make up not a simple plurality, but the integrity of the global system: production, demographic and agricultural.

The 15-year study of the dynamics of socio-economic systems was based on the functioning of the dynamic model of world interaction during the fifteen-year period. This period was complicate by the post-war energy crisis of 1970-1975, which on the basis of the model of "war of civilizations" by S. Hutington was characterized as a confrontation of raw countries of the South against the industrial North, as well as often interpreted as a structural crisis of the post-war economic model, and the study itself contains accents on the coverage of the shadow processes of its course.

The theory and methodology of the dynamics of global development are presented in the studies of J. Forrester as a reflection of the effective interaction of economic, social and environmental systems in the most general aspects of the dynamics of the world system. The dynamics of the world model formed on this basis does not reflect all the problems associated with the general trends of global development, and therefore, many important variables had to be neglected. At the same time, each of the created models is most consistent with the time of its creation, replacing the previously created models, which were considered less accurate and require improvement efforts.

The global system at each stage of its development is faced with overcoming the contradictions formed by changes in the structure of production, uneven development between regions, changes in the number and structure of the population, differences in living standards, increasing pollution. In this connection, there is a growing awareness of the close relationship of the elements of the global system, the understanding of the dependence of changes in one sector of the system because of changes in the other. Thus, the growth of production of industrial goods and food contributed to global population growth, but also to the reduction of fertility with the growth of living standards. At the same time, the growth of production generates problems of depletion of natural resources, which requires the use of the option of transition from dynamic growth to the formation of a state of global equilibrium. Therefore, exponential growth should not be equated with progress.

Progress is characterized by the formation of a structure of mutually balancing forces at the global level, which reduces the excessive burden on the environment. The change of the old one and the formation of a new structure of the global system is materialized by the plurality of alternative options for future development, emerging due to the close interdependence and interaction of the elements of the system. The significant increase in social production with a positive dynamic of all factors of production will lead to a crisis of environmental pollution, reduce fertility, increase morbidity, increase mortality and reduce production. But this trend will be formed primarily in relation to underdeveloped countries, which are characterized by a low level of requirements for the environment protection, which entails the placement of the dirtiest industries, in areas with high population density, low level of health care and quality of life.

In 1961 the monograph "Fundamentals of enterprise Cybernetics (industrial dynamics)" was published, and in 1969 "Dynamics of city development". In the first work J. Forester presented the theory of structures in dynamic systems, and in the second one he applied it to study the processes of growth and stagnation of urbanized regions. In further studies based on the application of modelling methods in complex systems he defines this method as "system dynamics" used for a comprehensive study of economic, social and political processes at the macro level. In the future, an even more ambitious task is set – the creation of a global model of economic systems functioning, which would be fully reflected in the processes in real systems: in countries, business, family, natural environment.

The former world models contain interrelations of variables of five levels – the population, investments in industrial and agricultural production, an assessment of available and consumed natural resources, environmental pollution its influence on quality of life, its duration, demography. These models are only preliminary, because they are embodied only in the attempts to reflect the complex processes that are inherent in real complex dynamic systems. They also contain significant flaws related to the role of the subjective factor and innovation based on it, which significantly reduces the content of the models themselves. But the experience gained of programming and the formations of system simulation models generate predictions of the future development.

At the same time, forecasting of economic dynamics should consider a number of insufficient validity of variables of system models. In this connection, the generated models reflect only the likely trends of this development. This is evidenced by the following: first, the indicators of natural resources included in the model reflect only explored reserves, but do not take into account their actual volumes; second, scientific discoveries and developments for decades have solved the problem of replacing elements of natural resources with their inorganic substitutes; third, the constant change in the structure of social production is based on the emergence and use of new technologies and constantly changes the structure of consumed natural resources, as well as allows to increase the production of their

inorganic substitutes, based on available reserves, affordable and low-cost sources of natural resources. Therefore, this variable will largely depend on the subjective factor, as well as the development of directions and volumes of innovation.

In case that natural resources, as a result of these circumstances, are not a significant constraint on socioeconomic development, the pollution of the environment is a clearly growing threat not only to limit the pace of development, the volume of products, but also such important variables of quality of life as its duration, morbidity, demography. According to global statistics, the development of the crisis phenomena of the environment shows an increase the pollution of the environment in more than 40 times since 1970. That is, the dynamics of pollution increases, approaching the corresponding indicator of the dynamics of decomposition the pollution, and surpasses it for some types of waste. It should be borne in mind that pollution is increasingly progressing in developing countries. This is due to the increase in the structure of waste products of the chemical industry, in requiring the use of processing technologies since the terms of their decomposition, especially from polypropylene and other types of food and non-food plastic, are determined from 100 to 500 years or more.

Economic dynamics of social development often generates problems, the resolution of which causes the emergence of new problems. This is due to several reasons: the solution of the problem in the current period can lead to problems in the long term; the solution of a local problem can lead to a problem for the whole system; only the illusion of solving the problem, with the corresponding costs.

3 DATA AND METHODS

In the study of theoretical and methodological foundations of economic dynamics to reflect the interaction of economic, social and environmental systems used the results of fundamental theoretical studies of the relationship of the evolution of economic development and the increasing role of ecology in the interaction of man, means of production and the environment, determining the main variables in the creation of models of forecasting future development and identifying its main trends.

In the course of the study, a subjective approach was used, which determines the establishment of the active impact and interaction of business entities on the external environment, and the identification of patterns that determine the formation of the main trends in economic dynamics through the use of empirical positivism with a detailed study of economic processes and phenomena.

The most important research methods used were: analysis used to separate the process of economic dynamics as a single interrelated integral process into its separate components, to establish the features of participation in this process, to study each of these parts, to identify the essence, patterns, trends in socio-economic processes and is the starting point for the construction of theoretical models; synthesis used to determine the characteristics of economic dynamics at different stages of the evolutionary process as a whole of its individual components; induction – to identify common patterns of economic dynamics in the interaction of economic, social and environmental systems; deduction; logical and historical approaches; comparison. Thus, the methods used in the study are quite diverse, allowing a comprehensive study of economic phenomena and processes in the dynamics of development.

4 RESULTS

The study briefly and concisely presents the evolution of theoretical and methodological approaches in the study of the relationship of economic dynamics and economic growth based on the interaction of economic, social and environmental systems.

It is possible to identify those features that are largely an obstacle to ensuring a close connection between the increase in the pace of economic dynamics and the improvement of the sustainability of the environmental system.

First, the development and continuous improvement of the theoretical and methodological foundations of the mechanism are closely related to the scale of economic reforms, the dynamics of changes and a set of compensatory environmental measures.

Secondly, considering the dependence of ecological identity on the development of socio-economic and environmental tools provides a solution to the environmental problem as a key problem of quality of life.

Third, the natural-adaptive determinants of economic development should be closely linked to the development of the "green" economy by its environmental sustainability and increasing the value of natural resources.

Fourth, the development of theoretical and methodological foundations of modelling provides the formation of ecosystem signals on anthropogenic impact on it in the medium and long term.

Fifth, the development of mechanisms for the spatial increase of economic capacity corresponds to the reduction of environmental load.

Sixth, the development in the public consciousness of understanding the relationship of culture of material and spiritual production is an integral part of the environment.

5 CONCLUSIONS

The evolutionary nature of the dependence of economic dynamics and economic growth on the basis of the interaction of economic, social and environmental systems indicates that each new qualitative stage of sustainable development of the national economic system requires a systematic approach to the formation of a balance of these three fundamental components of socio-economic progress.

According to the authors, the achievement of the current level of material production, and the potential that is fraught with the economic dynamics of future economic growth of the global system poses the problem of interdependence of social, economic and environmental systems. The constant increase in the dynamics of socio-economic development without an appropriate compensation package of environmental measures will certainly lead the ecological system to a critical state, when the quality of life will depend on the restoration of the elements of the environment.

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Interrelation of Social, Economic, Environmental Problems in Context of Sustainable Economic Development

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Abstract

The article deals with the main factors of sustainable development of the economy and its individual subjects, the relationship between the social, economic, environmental categories of sustainable development, as well as contradictions and opposition arising in the process of transition to a new model of economic development and the necessary measures for the implementation of this transition.

Keywords: development, ecology, ecologization of economy, green economy, model of consumption, economic growth, self-limitation

1 INTRODUCTION

The issue of sustainable development is acutely perceived by the globalizing society. Economic globalization is not automatically followed by the solution of economic, social and environmental problems.

The emergence of new technologies, digitalization of the economy, new economic risks lead to a change in strategic guidelines. For each national economy, the problem of sustainable development is unique, considering the pace of its integration into the world economic space and the speed of innovative economic changes.

2 METHODOLOGY

The concept of sustainable development requires clarification of the category of "Sustainable economic development".

The traditional economic model has exhausted its potential and should be replaced by a new, so-called sustainable development model.

The term "sustainable development", which is fixed in our business language, is not a very accurate Russian translation, in the context of the dominant ecological and economic discourse on sustainable development, which refers to the long-term reproduction of a balanced ecological, social and economic development of society.

Under sustainability, as a rule, understand the ability of a system to automatically manage its normal state, functioning, while providing resistance to various influences; the ability to maintain it in spite of the action of various forces.

The sustainability of the socio-economic system is understood as the creation of conditions that would ensure a sufficiently high-quality level in the long term with real income growth.

Results

Sustainable development is a dynamic change in its quality and quantity. For most researchers of this important problem, sustainable development also implies its functioning, reproduction and self-preservation in the harmonization of interaction with the environment.

In the second half of XX century. one of the main trends of socio-economic development is the greening of the economy as a fundamental transition from costly to nature-saving method of management, as well as the transition from extensive use of resources and mainly intensive, that is, the extraction of the maximum possible economic effect from the minimum possible involvement of natural resources in the production and minimization of violations of living space, the use of renewable, or regenerative, "green" energy — energy from sources that, on a human scale, are inexhaustible.[1] of Course, the solution of economic problems is not the only and primary, since

economic problems are closely related to social, environmental and represent a mutually permeating and interacting system.

The social imperatives of sustainable development are fundamental social factors that, on the one hand, necessitate the transition to sustainable development, on the other hand — the possibility of implementing its basic principles.

Among them are:

- social risks and challenges (demographic, related to the process of population ageing; personnel; deepening income gap and high level of social inequality; risks caused by drug addiction; risks of social instability, etc.));

- social and economic trends and changes relevant to the goals and principles of sustainable development (formation of a new way of thinking, adequate to the principles of social responsibility and sustainable development; formation of the phenomenon of socially responsible consumption and socially responsible investment; increasing the role of human and social capital in ensuring economic growth);

- social drivers (increase of social responsibility of business entities, formation of the institution of corporate social responsibility, new social policy, increasing the role of companies as subjects of social policy, reduction of social inequality, equality of opportunities and results, formation of civil society). [2]

Currently, various international research organizations are actively working on the development of environmental and social indicators of sustainable development.

According to some authors, the main social indicators of sustainable development include:

the extent to which benefits are available to meet the basic needs of the population (health services, water, etc.).);

- the degree of vulnerability, social insecurity of certain social groups (exposure to social risks — shocks), for example, due to loss of work, health, poor quality of social capital;

- the level of income differentiation of the population (Gini index); material and social inequality; social mobility;

— unemployment rate.

The important parameters (criteria) of social stability and sustainable development in General should include the level of personal social stability of the individual, understood as the ability to adapt to rapidly changing conditions of life. It is obvious that the level of social stability of a person is determined by age, level of health and education, his social status, level of income and mobility (territorial and professional), degree of protection from social risks.

In this regard, attention should be paid to the indicators developed by the world Bank: the degree of resistance to weather-climatic anomalies (cost indicators of the corresponding losses, indicators of the number of people affected by them); the stability of citizens to the volatility of prices in commodity markets, including energy prices (the number of citizens experiencing problems due to changes in the prices of goods and services during crises); the degree of availability of basic goods and services (the proportion of the population without access to clean drinking water, sanitation); the level of poverty[3]

The main principle of greening the economy – a systematic and holistic view of the unity of nature and society. A form of manifestation of this unity is material production, which is "intertwined" in the natural processes of nature in close relationship with the economic, technological, social, environmental processes of nature and is, in fact, a biosocial ecological and economic system. Therefore, any decision-making, the use of socio-economic incentives and levers should be focused on economic, social and environmental criteria.

Another important principle of greening the economy is the mediating role of social production in the interaction of nature and society. Material reproduction in a broad sense is the production of not only and not so much material goods, but also the reproduction of social relations, of man himself and of natural resources, which are the basis of any production process.

However, it should be noted that the modern world is moving in the opposite direction to sustainable development. And there is no hope of changing the trajectory towards sustainable development soon. Unfortunately, humanity is not yet able to stop the destruction of current processes and is not ready to

accept the paradigm of sustainable development with the requirements of self-restrictions and changes in the consumer model.

The prevailing values (power, wealth, etc.) increase the tension between the demands of man and the possibilities of the biosphere. Modern anthropocentric ethics reflects these opportunities rather than the prospects of sustainable development in the information age. The ethics of anthropocentrism lacks the main thing from the point of view of sustainable development strategy: understanding of the biosphere as the main and determining partner of coevolution of man and nature. Currently, the consumption of mineral resources doubles in the world every 10 years, with more than 90% of the resources used by man goes to waste, cluttering up our planet [5]

The inertia of the world economy also hinders the transition to a new world economic model. Therefore, the UN experts have developed a new global course of the world economy, where they proposed using specific measures to implement the transition to a "green" economy, in particular, the use of new models of pricing and taxation, public procurement and public investment policies, full support for innovations related to the development of economically clean technologies, etc. the "Green" economy will not replace sustainable development, which remains the main goal, but its achievement depends on the transition to a new "green" model.[4]

Unfortunately, the Russian situation of ecological and economic development is far from acceptable norms. In the areas of concentration of the main population, environmentalists observe strongly oppressed ecosystems, with a large anthropogenic load, their recovery is almost impossible. Almost half of urban agglomerations are characterized by excessive pollution of air and drinking water, unsatisfactory situation with waste, depletion of agricultural land, forest fires, there are real threats of extinction of many species of animals and plants.

The introduction of the principles of sustainable economy in Russia requires the implementation of the necessary measures, including:

- toughening of environmental legislation, adoption of laws on disadvantaged environmental areas, national sustainable development program;

- universal provision of environmental monitoring, rejection of harmful practices of permits for emissions and discharges, mandatory use of the mechanism of environmental state expertise of projects;

- immediate start of works on minimization and elimination of environmental damage;

- creation of a system of incentives for economic entities with the establishment of responsibility for economic activities that do not meet environmental requirements and are harmful to the environment. [5]

Improvement of ecological situation in the world it is possible to achieve the transformation of cultural values in an ideological transition to moderation, self-restraint and environmentalism. Humanity is aware of the economic problem of limited resources, but their rational use requires responsible behavior of economic entities, which is very difficult in the era of consumption, on the one hand, and the imperative of profit, on the other.

3 SUMMARY

Humanity must overcome the deepest self-centeredness, to abandon the narrow national selfishness and to build the global ecological safety based on the relationship and address the social, economic and environmental problems in the context of sustainable economic development. This will require concerted action on a global scale and, most importantly, global thinking and awareness of the urgent need to change people's behaviour, compliance with the norms of "global morality", implying environmental self-restraint. The role of Russia in solving these global environmental and economic problems is very significant. Russia has huge territories, including those that are not used in economic turnover and serve as a kind of reserve in the sustainable development of the entire ecosystem. [6]

These global problems are of a long-term nature, concern the interests of different generations, they are international and not confined within the borders of individual countries, so their solution is possible only within the framework of consolidation and international cooperation.

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System Challenges to Sustainable Humanity Development

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Abstract

The purpose of the research is to analyze the challenges to sustainable world development, associated with the evolution of humanity as a system, considering the interrelated processes of demographic transition, growth of knowledge and GDP dynamics. It is shown that the mathematical model of human population during demographic transition, based on the women's choice between having many children and employment, is in good agreement with the average population projection according to the UN. It was determined that the demographic dynamics begin to deviate from a hyperbolic growth after the value of the world GDP per capita achieves $(G/N)_{dem} \approx 5070$ USD per person in international dollars of 2017.An analysis of the growth over time of the amount of explicit knowledge (Z) accumulated in the largest libraries of the world showed that their dynamics are well described by the dependence $Z \approx 30 \cdot (N(T-25)/N_0)^{1.25}$. It is shown that the global GDP growth is proportional to the number of people and the amount of explicit knowledge: $G = k \cdot N(T-25)^{2.25}$. As a result of the existence of the maximum number of people $N_{max} \approx 11$ billion, the amount of human knowledge, as well as the average GDP per capita have a value limit, with $Z_{max} = 60$ million CB, $G_{max} = 54{,}500$ international dollars of 2017. The transition to the specified limit values in less than a century will lead to a drastic change in the world dynamics compared to the current dynamics. These changes can cause destabilization of world relations, thus threatening with international conflicts.

Keywords: sustainable development, systematic approach, world dynamics, demographic transition, GDP, forecast, knowledge, limits of growth

1 INTRODUCTION

What are the most important challenges that expect us in the future? In order to understand it, we need to pay attention to the development of humanity as a system. First, it grows in number, and until 1960, this growth followed the hyperbolic dependence $N = C/(T_1 - T)$, where T is time and $T_1 \approx 2025$ is the date of demographic singularity [1], [2]. But after 1960, as a result of the birth rate reduction to mere reproduction, the process of “demographic transition” started. The population of the Earth began to follow the logistic (S-shaped) dependence with the expected achievement of a stable population of about 11 billion people [3]. Is this transition one of the main challenges to sustainable development? Until now, there is no agreement among researchers regarding the main cause of demographic transition and a sharp decline in the birth rate in most countries. And since the reasons are not clear, one cannot be confident in further forecasts of the demographic dynamics and possible methods for mitigating negative consequences. But this is only the first batch of problems, the real situation is much more complicated. It is important that the change in the birth rate essentially means that humanity as a system has passed into a new state and such transitions for exceptionally complex systems occur only in extreme cases. The change that has occurred means that many other important characteristics will also be changing, and, above all, the dynamics of the knowledge system and economic development will. Humanity is the only known system of reason known to us and it has been constantly developing and growing over three million years. In connection with the demographic transition, there is a threat of stagnation of its rational activity, as the number of the reason carriers is stabilizing [4]. That is a challenge. But on the other hand, an alternative threat is posed by artificial intelligence, which has the potential to replace the first system of reason. It should be noted here that we touched upon the issue of analyzing the knowledge of humanity. The knowledge exists in two basic forms: codified (explicit) and non-codified, whose carriers are people. Both types of knowledge are very important for the development of humanity as a system. But at present, the theory of knowledge management is at the beginning of its development [5] and does not set an enough ground to develop reasonable programs of state and international politics. The lack of understanding of the role of knowledge for global development contributes to the creation of an environment favorable for

various demographic myths. For example, Thomas Malthus [6] popularized the idea of the need to control the population growth rate to make it consistent with the slowly growing food production capacity. As shown by further studies, the population of the planet grows much faster than expected by T. Malthus (not exponentially, but as a hyperbolic dependence, which tends to infinity) and means of subsistence fail to significantly limit the population growth in real life. But the ideas of T. Malthus continue to influence public consciousness.

More than 50 years ago, one of the progenitors of the systems approach, Jay Forrester [7], attempted to calculate the World Dynamics. But he did not consider the factor of scientific and technological progress as a resource for the humanity development and made the same mistake as Malthus had made 200 years before. His apocalyptic predictions unwittingly generated projects to reduce the burden on nature at the expense of the least developed peoples. Another threat is associated with the cyclical development of the world economy based on the growth of knowledge and technological innovations [32]. The resulting technological revolutions in conjunction with demographic changes lead to a situation when the leaders of economic development give way to other countries. Each of such changes leads to international conflicts that have already caused several world wars, both “hot” and “cold” ones. The current level of technical development of humanity makes it possible for such conflicts to end up in a global catastrophe. This is one of the most critical threats to sustainable development. But without a proper understanding of the development processes taking place in the world, the institutions of society and top-level decision-makers cannot make the right decisions. Therefore, the analysis of these processes is a very relevant problem.

This paper considers challenges to the sustainable development of humanity as a single system that is in a transitional state, from the accelerating growth to constant global characteristics of the population, knowledge, and world wealth.

2 METHODOLOGY

To study the challenges of sustainability of humanity, we used systems analysis as the main methodology [8], [9], [10]. At the same time, we used the system diagram of the knowledge-based development of humanity, presented in Fig. 1 [4].

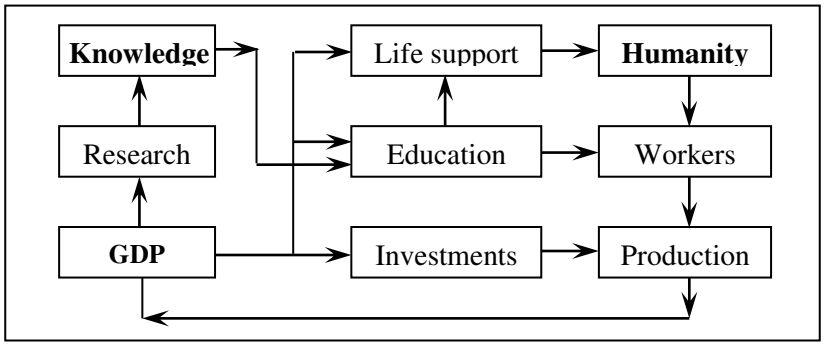

Fig. 1. Diagram of the humanity development with account of knowledge

According to this model, the growth of population results from the growth of well-being, characterized by the GDP value. The growing humanity creates more knowledge that directly accelerates the growth of production and, accordingly, the GDP. To calculate the demographic dynamics, we used a mathematical model reflecting the system diagram presented in Fig. 1. The task was to find an analytical solution to this problem in order to identify the causes of the changes and the main influencing factors, disregarding any situational and minor factors. The obtained analytical dependencies were compared with the current forecast of the world demographic dynamics [3].

The growth of the human knowledge volume was analyzed using S.P. Kapitsa’s hypothesis [2], which assumes that the system properties of humanity are caused by the information interaction, as well as the hypothesis if this interaction is fulfilled through an explicit knowledge exchange. The amount of knowledge (Z) was determined based on the data on the storage volume in the largest libraries of the world in various periods. For this purpose, we introduced the concept of Conventional Book (CB), a book that takes 1 MB of memory when digitized. The data on the amount of knowledge in different periods were approximated by a power dependence. The global GDP growth was analyzed based on the previously obtained results on the ratio of GDP at PPP and the amount of the human knowledge Z

[4], using current data and updated PwC forecasts of the GDP value. Based on the results obtained, we derived a formula for the maximum global GDP at PPP.

3 LITERATURE REVIEW

The most important publications for this research are the studies analyzing humanity as a system and demographic dynamics.

3.1 Humanity as a single system

In [1], it is shown that the population (N) of the planet Earth has been changing over a long period in accordance with a hyperbolic dependence (1) on time (T), where $C \approx 18 \cdot 10^{10}$ ppl.•years, and $T_1 \approx$ year 2025.

$$N \approx C/(T_1 - T) \quad (1)$$

P. Kapitsa drew attention [2] to the fact that the population growth rate during this period was proportional to the number of people squared (2):

$$dN/dT = N2/C \quad (2)$$

Usually, the growth rate of an unrestricted system of unreasonable living organisms is proportional to its population in accordance with the following formula (3):

$$dN/dT = N/C \quad (3)$$

In this case (3), the size of the colony grows exponentially, that is, very quickly. At the same time, dependence (2) is characterized by the fact that with a small population (N), it grows slower than the exponent, and with a large population, it grows much faster, tending to infinity for time $T \approx T_1$. This happened in the 20th century, when the number of people almost doubled. This gave rise to concerns about the critical overpopulation of our planet. It should be noted that equation (2) shows that humanity, unlike the system of unreasonable living organisms (3), grows as a single system. If we divide humanity into two equal parts isolated from each other, the growth rate of each of them, according to equation (2), will decrease by 75%, and their combined growth will reduce by half. What is the reason for the quadratic dependence of the population growth rates? S.P. Kapitsa analyzed the behavior of humanity as a single system and summarized as follows: “According to the obtained results, we can state the unity of the humanity development as a single whole and consider it as a certain global structure, a global *superorganism* embraced by a common information interaction” [2]. Despite the rapid population growth in the 20th century, the number of people could not reach infinity, as, according to the systems approach, there will be many limiting factors (feedbacks). At least one of them would certainly manifest itself. S.P. Kapitsa proposed an equation for describing the population growth in such a case (4) and its solution (5), which well reflects the real dynamics of the population in the process of demographic transition [12].

$$dN/dT = C/((T1 - T)2 - \tau 2) \quad (4)$$

$$N = (C/\tau) \cdot Arcth\ ((T1 - T)/\tau) \quad (5)$$

However, it was noted in publication [13] that this solution “does not reveal the essence of the existing laws and remains a phenomenological statement of the discovered empirical regularity.” If the limiting factor were exhaustion of the planet’s resources, including self-healing capabilities, humanity would face an irreversible situation, which was generally described by Dennis L. Meadows et al. [14], [15]. In this case, the extinction of the civilization would be highly likely. But some time before the exhaustion of the Earth’s resources, another feedback factor manifested itself and began to inhibit the hyperbolic growth of population since 1960. According to M. Kremer, it was the *unwillingness* of wealthy families to have many children [16]. Accordingly, M. Kremer proposed an empirical dependence of the relative growth rate of the population ΔN/N (birth rate minus mortality) on the gross product per capita (G/N). His calculations also are in good agreement with the real dependence of the number of people in the demographic transition period. However, it is not clear to what extent this agreement is provided with a significant number of empirical parameters used in the study, as noted in the publication [13]. In addition, a decline in the standard of living, for example in Russia after 1992, did not lead to an increase in fertility, which means that the ΔN/N function does not depends only on G/N and can allow hysteresis, that is, a behavior depending on the history of the phenomenon (while the progress of the direct and reverse processes can vary). Another version of the demographic

transition causes was proposed by A.V. Podlazov [17], who believed that as technologies develop, their life-saving efficiency, i.e. their ability to reduce mortality, decreases. However, publication [13] indicates that this hypothesis is not consistent with the reality, since demographic transition is not associated with the impossibility of reducing mortality, but with a decline in the birth rate.

Finally, publication [13] substantiates the fact that the demographic transition cause is the increase in female literacy in the course of modernization (technological progress), which is to a certain extent confirmed by statistical data [18]. Thus, at least four mathematical models were developed, which differently interpret the causes of the demographic transition of humanity as a system and are consistent with the data on the growth of the world's population.

There are also many studies, in which the process of demographic transition is considered as the total of demographic characteristics in various countries, forecasts of the Population Division of the UN Department of Economic and Social Affairs [3], [20]. Such studies are much more extensive and complex, as they require considering the age distribution of the population of all countries, the dynamics of fertility, migration, and welfare growth, as well as other demographic factors. As a result, it is difficult to identify a limited number of parameters defining the phenomenon in them. As a rule, they also do not sufficiently consider the system characteristics of the demographic transition, which are very important, since humanity develops as an interacting system.

4 RESULTS

Below are the results of our analysis of the conducted studies analyzing the challenges of sustainable world development associated with the evolution of humanity as a system.

4.1 Human population growth model

Above, we have considered several system models of demographic transition. The last of them, which considers the results of previous authors' studies, was presented in the publication of A.V. Korotaeva et al. She proceeded from the fact that the cause of demographic transition was the increasing literacy among women. However, an analysis of the impact of the growth of literacy (in tens of percent) and GDP (PPP) per capita in the world (in tens of thousands of international dollars of 2017) in the period 1950–2010 (Fig. 1) on total fertility rate (TFR) shows that the birth rate began to decline despite the monotonously changing literacy and GDP after 1965, for no apparent reason [21].

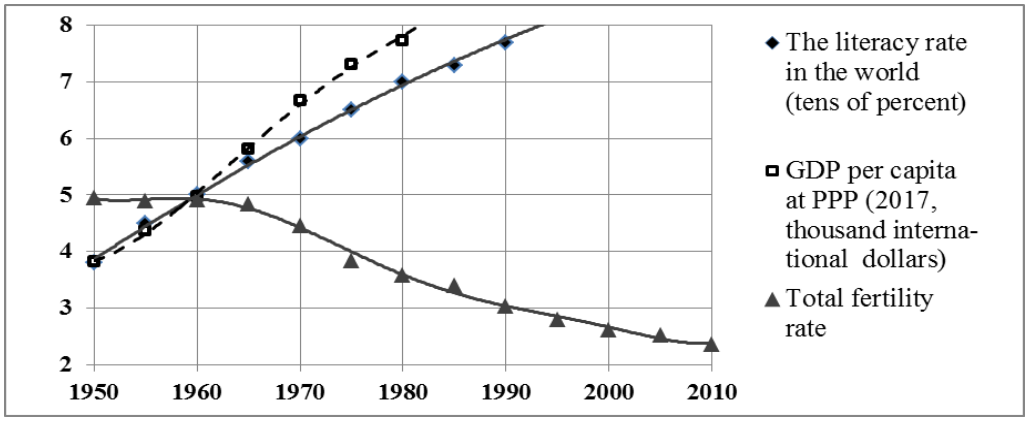

Fig. 2. Ratio of TFR, literacy and GDP (PPP) per capita

Up to this point, the impact of literacy and GDP per capita on the birth rate (the number of children born per woman) was unnoticeable, although the literacy rate reached a significant level of 55%. Although women's literacy somewhat lagged the average [22], it was quite high and its rapid growth would have manifested itself in the TFR dynamics, if the main cause were women's literacy. This figure shows that the change patterns of the dynamics of literacy and GDP per capita do not affect the birth rate. It seems that in the process of industrialization, which occurred at about the same time in many countries, the involvement of women in production activities and their literacy growth were closely related. It became difficult to work as an employed person and raise children, which led to a decrease in the birth rate to a level that allowed combining work with raising children. Thus, the growth of literacy is not a cause, but a consequence of the economically important process of involving women in production activities. It seems logical to assume that the cause of the demographic transition was not just the desire of wealthy families not to have many children, as M. Kremer believed,

but rather their economical reasoning. Families chose between two alternative behaviors for women: work for hire or have many children. The more a woman can earn, the more attractive the option of employment is for her. Such a hypothesis allows us to form a mathematical model of demographic dynamics. It is since the population growth **dN** during time **dT** is proportional to the following factors:

Population **N**;

The value of excess GDP per capita **(G/N–m)**.

The limiting factor, whose profile corresponds to the choice of alternative cost described above, including an increase in the birth rate at low **G/N** values and its decline at large **G/N** values.

In order to make the model more convenient for analysis, we could take the value of the limiting factor like the well-known equation of the logistic growth of unreasonable organisms. However, here we chose GDP per capita as the limiting factor, as its growth contributes to women's choice of employment rather than having many children. As a result, this system has the following form: **1 – k•G/N**. In this case, the differential equation for the growth of the number of people has the following form (6):

$$\mathbf{dN/\,dT = A \cdot N \cdot (G/N - m) \cdot (1 - k \cdot G/N)} \quad (6)$$

To express G/N in an analytical form, we used expression (7) proposed in [13]:

$$\mathbf{G = N \cdot (m + \gamma N)} \quad (7)$$

Constants γ and m have the following values: $\gamma = 1.57 \cdot 10^{-6}$ dollars/person^2•year; m = 333 dollars/person•year in international dollars of 2017. Using expression (7), we transformed equation (6) to the form (8) or to the simpler one (9) [2].

$$\mathbf{dN/\,dT = A \cdot \gamma \cdot (1 - k \cdot m) \cdot N2 \cdot (1 - k \cdot \gamma \cdot N/(1 - k \cdot m))} \quad (8)$$

$$\mathbf{dN/\,dT = (1/C) \cdot N2 \cdot (1 - N/N_{max})} \quad (9)$$

To determine the constants in equations (8, 9), we used two passages to the limit. With $N/N_{max} \to 0$, equation (9) should be converted to (1), and with $N/N_{max} \to 1$, the condition dN/dT = 0 and **N =** N_{max} should be fulfilled. As a result, we found the connection between the constants A, k and C, N_{max} (10, 11)

$$\mathbf{A \cdot \gamma \cdot (1 - k \cdot m) = 1/C} \quad (10)$$

$$\mathbf{k \cdot \gamma/(1 - k \cdot m) = 1/N_{max}} \quad (11)$$

The resulting equation for the growth of the human population can be tested for adequacy. For example, with a known value of the derivative dN/dT, it allows finding the maximum population of humanity (12) and compare it with the known solutions, e.g. with the UN forecast.

$$\mathbf{N_{max} = N/\,(1 - C(dN/dT)/N2)} \quad (12)$$

For example, in 2015, the growth rate of the Earth's population was dN/dT = 84.6 million people per year, N = 7.383 billion people. [3]**.** Taking C = 180 billion people•years, we obtained the value of $\mathbf{N_{max}}$ = 10.25 billion people, which is less than the average forecast of the UN and the model of S.P. Kapitsa by approx. 10%. It should be noted that according to the UN forecast, there is a 20% probability that the population of the Earth will be by 10% less than the average forecast by 2100 [3], which characterizes the accuracy of the estimate (12).By introducing the dimensionless variable $X = N/\mathbf{N_{max}}$, we can convert equation (9) to the form (13), the solution of which has the form (14), and when returning to the variable N, the solution has the form (15).

$$\mathbf{(1 / (X2 \cdot (1 - X)) \cdot dX = (N_{max}/C) \cdot Dt} \quad (13)$$

$$\mathbf{1/X - Ln\,(X/(1 - X)) = (N_{max}/C) \cdot (T1 - T)} \quad (14)$$

$$\mathbf{T = T1 - C/N + (C/N_{max}) \cdot Ln(N/(N_{max} - N))} \quad (15)$$

Fig. 2 shows a comparison of solution (15) with C = 160 billion, N_{max} = 10.5 billion, T_1 = 2022 with the average forecast of the demographic dynamics of the UN made in 2015 [3]. The data for the period of 1900–2050 correspond to publication [23].

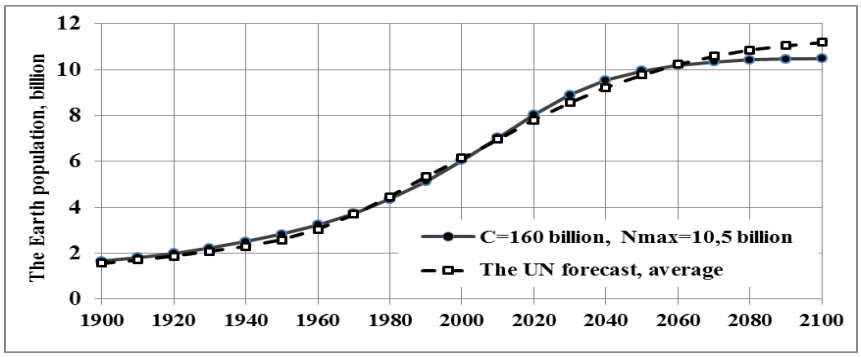

Fig. 3. Comparison of the obtained solution of demographic dynamics (15) with the average world population forecast of the UN in billions of people

It is evident that, in general, these two dependences are fairly consistent (note that the parameter C, according to the data during the hyperbolic growth [2], is about 180 billion, but for calculating the demographic transition, the value C = 160 billion provides a better agreement with the previous values). The highest deviation of the solution (15) from the UN data covers the period of 1940–1960 and reaches 9% of the current population (with no more than 6.3% in 2100). This is since the theoretical model does not consider the factor of population declines during the Second World War, as mentioned by S.P. Kapitsa [2], as well as after the war. An analysis of the UN data [3] on the annual increase in the world's population in millions of people shows that the demographic crises caused by wars later manifested themselves several times, as shown in Fig. 3 (the trend line is a cubic polynomial in this case).

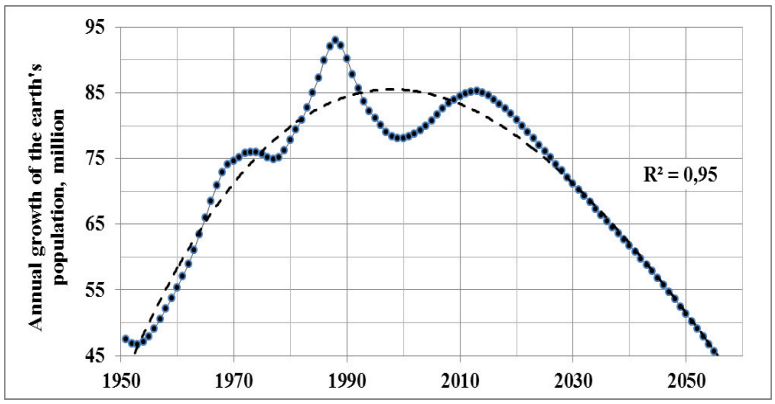

Fig. 4. Fluctuations in annual population growth (in millions of people)

It is necessary to bear in mind the presence of such fluctuations, since they reflect the high vulnerability of demographic processes to wars. In particular, the demographic processes in China, Russia, and Japan had a high impact on the fluctuations in the rate of the world population growth, as shown in Figure 4 according to the results of the UN data analysis [3]. In Fig. 4, charts are given in millions of people, being quintupled for Russia and Japan.

As can be seen from Fig. 4, the largest fluctuations in population growth took place in China and Russia, with three noticeable population increment regressions, reaching more than 50% of the maximum value. In Russia, the first regression took place during the Second World War, and in China, it happened after the war. Although the detailed projections, such as the UN forecast, are more detailed and consider diverse demographic realities, the proposed analytical solution embodies additional system information about the process of demographic transition, which is analysed below. The role of the factors A, k (10), (11) is considered in equation (8). The value k determines what value of G/N causes women to prefer employment instead of raising children. This is precisely the economic meaning of demographic transition. The dimension of k is [people·year/dollars]. From the above expression (11) for the factor k, it is equal to $k = 1/\gamma \cdot N_{max} \cdot (1 + m/\gamma \cdot N_{max})$. Since $m/\gamma \cdot N_{max} \approx 0.015$, then $k = 1/\gamma \cdot N_{max}$ with an accuracy of 2%. For N_{max} = 11 billion people, the value $1/k \approx 16{,}900$ dollars/person·year (in international dollars of 2017). A decline in fertility, despite an increase in welfare, becomes significant when the value of the limiting factor in equation (8) is $k \cdot G/N \sim 0.3$. At the same time $(G/N)_{dem} \approx 0{,}3/k \approx 5070$ dollars/person in international dollars of 2017. As can be seen from Fig. 1, this value reached this level in 1960, which marked the beginning of the global decline in the

birth rate. Equation (15) shows that the determining parameter of the process of demographic transition is the ratio C/N_{max}. The greater its value, the faster the demographic transition proceeds. With the typical of humanity values of C = 160–180 billion, $N_{max} \approx 11$ billion, the ratio is $C/N_{max} \sim 15$ years, and this period characterizes the demographic transition rate. There will be about five of such periods from 1965, when the effect of demographic transition began to manifest itself (Fig. 1), until 2040, when it will be mostly completed. On the other hand, expressions (10) (11), considering the small value of $m/\gamma \cdot N_{max}$, can show that $A \approx k/C \cdot N_{max}$. This determines the value of A as a characteristic of the rate of achievement of a GDP per capita value, at which the birth rate will decrease in the course of demographic transition. However, instead of the parameter A, it is more convenient to use the product C/N_{max}, which offers a convenient visual interpretation.

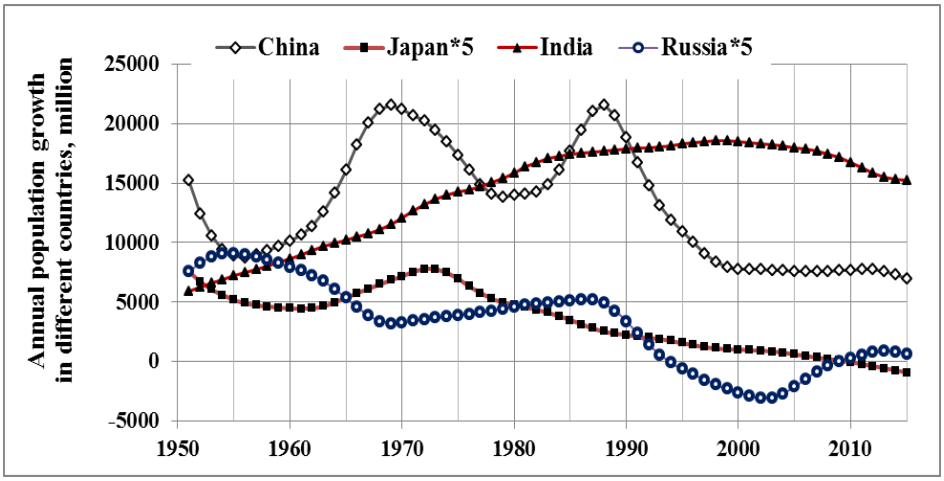

Fig. 5. Annual population growth in China, India, Russia, and Japan in 1950–2015

An analysis of the constants of the equations of population dynamics (9), (15) shows, which parameters of humanity as a system determine its growth and the process of demographic transition:

– at the stage of hyperbolic growth, the factor C is governing;

– near the demographic transition, of importance are: the value of GDP per capita, at which the demographic transition begins: $(G/N)_{dem} \approx 0.3/k \approx 5070$ dollars/person, and also the characteristic time scale of the transition: $T_{dem} = C/N_{max} \approx 15$ years.

An analysis of the equation of the dynamics of human population showed that all its characteristics had been established long before the process of demographic transition, and the transition itself occurs within the lifetime of a person (~75 years). The transition rate is what represents the main problem, since it does not allow time for people to adapt to new system conditions. And although the demographic transition has not yet been fully completed, there is very little time left until its end and it is necessary to foresee what kind of new problems it will bring.

4.2 Accumulation of human knowledge and its correlation with the GDP growth

Above, we considered the correlation between the human population and the GDP per capita, as well as paid attention to the significant manifestation of the system characteristics of humanity and to the fact that the system properties are associated with the information interaction of people [2]. It is important to identify the nature of this interaction. It can be assumed that it is associated with explicit knowledge, which is distributed primarily in the form of books and contributes to the development of the GDP production. As a source of information on the amount of knowledge, we used the data on the amount of books and brochures stored in the world's largest library, the Library of Congress [24]–[27], which retained ~14.5 million books and brochures in 1960, 30 million in 2000, 35.8 million in 2012, and 39.3 million in 2017. Of course, there are duplicates among those publications, but this is offset by the fact that the library does not have all the knowledge-containing materials published in the world. It is important that we used a unified approach to determine the dynamics of the amount of knowledge over time. Thus, we determined the amount of knowledge with an accuracy of an approximately constant coefficient. To measure the amount of knowledge, in contrast to the amount of information or

data, we used the concept of Conditional Book (CB), which, when digitized, has 1 MB of information. The amount of knowledge in the Library of Congress in this unit is provided in Table 1.

One of the largest libraries of antiquity was the Library of Alexandria, which was established in 300 BC approximately and stored between 100 to 770 thousand scrolls [28]. The amount of knowledge in each of the scrolls is estimated at 20% of a CB. Accordingly, the amount of knowledge in the Library of Alexandria is estimated at 80,000 CB.

Table 1. - The amount of explicit knowledge of humanity in the largest libraries

#	Library	Year AD	Population of the Earth (millions)	Relative number of people	The amount of knowledge in thousands CB	Knowledge in CB per thousand people	Relative amount of knowledge
		T	N	N/N0	Z	Z/N	$Z/(N/N0)^{1.25}$
1.	Library of Congress	2017	7,550	75,500	23,600	3.15	18.9
2.		2012	7,128	71,280	21,500	3.07	18.5
3.		2000	6,145	61,450	18,000	3.00	18.6
4.		1960	3,033	30,330	8,700	2.83	21.7
5	Library of Alexandria	–300	86	860	80	0.93	17.2

Obviously, the estimates of the knowledge amount through the number of books are not sufficiently accurate, but this approach may provide an answer to the question of the impact of knowledge on the development of humanity as a system. As can be seen from the table, the amount of knowledge per thousand people changes relatively slowly over time. This allows if it varies in proportion to the population in degree *n* close to unity. The last column of Table 1 shows the ratio of the amount of knowledge to the relative number of people (N/N_0, where N_0 = 100,000, being the conditional initial human population [1]). As can be seen, this parameter varies little over time. The relative standard deviation is 8.8%. Changing the exponent of *n*, we achieved the minimum value of the relative standard deviation of 8.0% for n=1.23, but in practice it is more convenient to use n=1.25. As a result, the global amount of knowledge can be approximated with formula (16) [29].

$$\mathbf{Z \approx Z_0 \cdot (N/N_0)1.25 = 20 \cdot (N/N_0)1.25} \quad (16)$$

Formula (1) can be also used to obtain an equation for the dependence of the global amount of explicit knowledge on time during the period of the hyperbolic growth of population (17).

$$\mathbf{Z \approx 1.5 \cdot 109/(T1-T)1.25} \quad (17)$$

Near the date of conditional singularity $T_1 \approx 2025$, formula (17) becomes untrue. However, knowledge is not created by all human beings, but only by educated people. Therefore, it is more accurate to use data on the population of the Earth about 25 years before the time T. If we accordingly adjust constant coefficients, formulas (16), (17) will be converted to (18), (19).

$$\mathbf{Z \approx 30 \cdot (N(T-25)/N_0)1.25} \quad (18)$$

$$\mathbf{Z \approx 2.25 \cdot 109/(2050-T)1.25} \quad (19)$$

In Fig. 5, curves (16), (18) with different time shifts and reference points from Table 1 are shown for comparison.

It is seen that the reference points are better approximated by equation (18), which is characterized by a more rapid growth of the amount of knowledge in the future, compared to formula (16) featuring no time shift. Thus, we have shown that due to the short duration of the demographic transition, one should consider a 25-year time delay needed for the labour resources to grow up. Also, we showed above that the knowledge of humanity grows somewhat more rapidly than the population of the Earth, at an exponent of about 1.25. Above, we used the expression for GDP at PPP (7) with a quadratic dependence on the number of people. However, over the recent period, it has become evident that this formula is not sufficiently accurate and should be refined for the purposes of predicting future development. In publication [2], it was shown that the value of GDP at PPP is proportional to the product of the population by the amount of human knowledge. Therefore, it is more efficient to approximate GDP at PPP with equation (20). The coefficient *m* after 2000 can be neglected as an insignificant value.

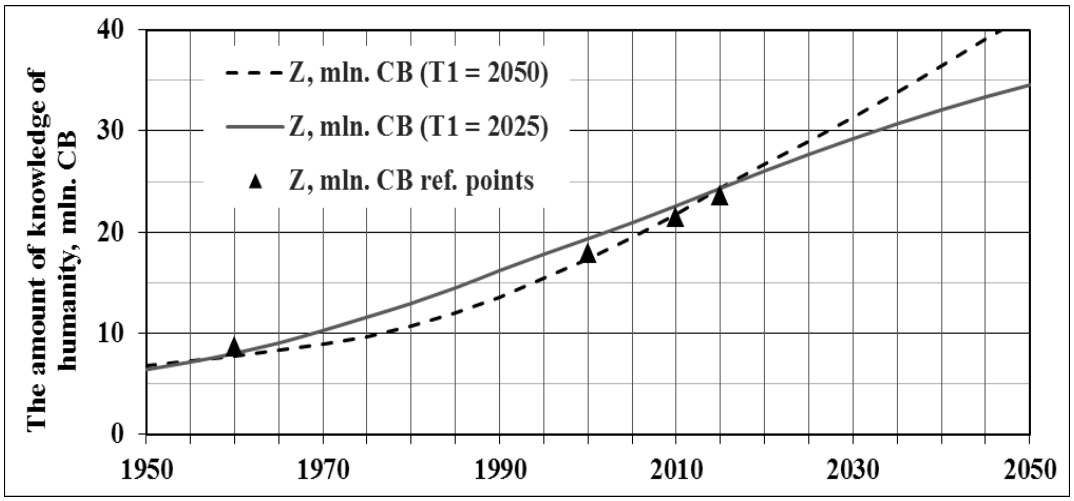

Fig. 6. Comparison of the knowledge growth formulas with different time shifts

$$G=k\cdot N(T-25)2.25 \quad (20)$$

Fig. 6 shows a comparison of the dependence (20) for k = 2.72 with available statistical data: A. Maddison [23] until 2008, and the World Bank data [30] for the later periods, in hundreds of trillions of international dollars of 2017 at PPP. It also includes the data on the world GDP at PPP forecast of the PwC company [31]. The dashed line shows the annual growth rate of the GDP at PPP in percent according to the formula of equation (20).It is obvious that the dependence of the GDP at PPP on time has a logistic form, which corresponds to the nature of the Earth's population growth. The statistical data for the period near the year 2000 are in good agreement with the dependence in equation (20), although they slightly exceed it in the earlier period. The PwC forecast for 2030 is in good agreement with dependence (20) but is somewhat lower for 2050. However, the PwC forecast for 2050 was revised in 2016 and reduced by about 7% compared to their forecast of two years before [32], so the agreement of these data with curve (20) can be considered quite acceptable, especially given the usual accuracy of long-term forecasts.

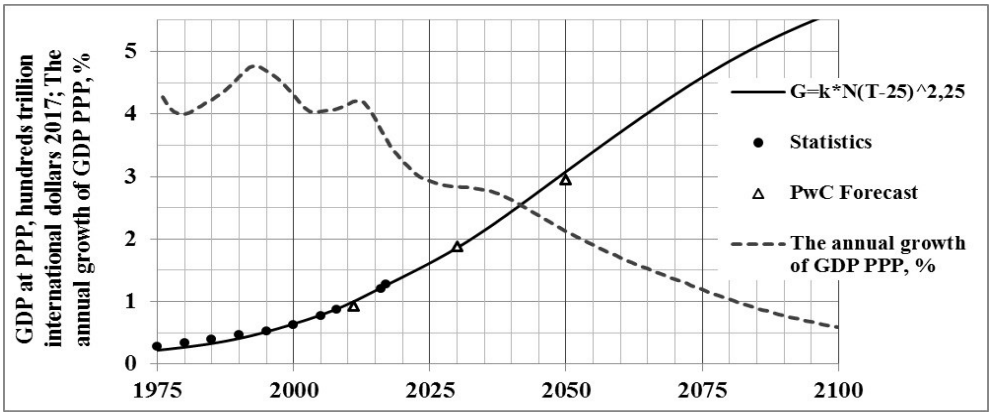

Fig. 7. Global GDP forecast according to the dependence $\mathbf{G = k\cdot N(T-25)^{2.25}}$

Annual GDP growth rate is rapidly decreasing from around 4% per year to 0.6% in 2100. Since this is the average growth rate for all countries, many countries will have an even lower or negative growth. Also, characteristic are fluctuations in the growth rates in the period 1975–2030, which mirror the fluctuations in the global population growth, as shown in Fig. 3.

An important result of the efficient use of the findings obtained from the analysis of human knowledge growth for predicting GDP growth is the understanding of the systemic consistency of important aspects of human activity, such as knowledge growth and economic dynamics. Both characteristics are also closely related to the growth of world population. In addition, we identified quantitative adjustments to formula (7) for the dependence of the world GDP on population in the form of equation (20), which will be important for obtaining subsequent results. It is extremely important that formula (7) used in the study and the limitation of the maximum population (N_{max}) imply that there is a limit to the GDP per capita growth, which can be obtained from formula (20) in the form of formula (21).

$$(G/N)_{ma}=k\cdot N_{max}1.25 \quad (21)$$

For N_{max} = 11 billion, $(G/N)_{max}$ = 54,500 international dollars of 2017. Currently, G/N = 16,940 dollars, so the average world GDP per capita can grow 3.2 times at most. For comparison, the world GDP increased by the same factor from 2001 to 2018. This limitation arises from demographic transition and from the fact that the population of the Earth ceases growing. Seemingly, the fact that the level of well-being of the population will not increase more than 3.2 times does not raise any concerns. But this means that the development of humanity will slow down dramatically. Economists in developed countries are already concerned by the slowing down growth of their economies, especially compared to the developing countries. But the same situation will gradually occur in the currently developing countries, too. It follows from the analysis that the steady decline in the economic growth rate is a systemically determined pattern of the humanity development. If we do not recognize this fact, world events, including economic crises and the commitment of developing countries to fighting for their rights, will lead to tensions between countries and conflicts, including armed ones. This seems to be one of the most fundamental causes of instability in the world for the next hundred years. At the same time, awareness of this threat can give rise to positive changes that can mitigate the risk of worldwide stagnation. In this study, we analyzed only the dynamics of explicit knowledge, but of no less importance is the pattern of changes of implicit knowledge that is contained in the minds of people. A more detailed analysis of the knowledge dynamics can provide us with approaches to overcoming the knowledge growth limit while stabilizing the Earth's population. There are resources, such as people who have not received any education and, accordingly, do not participate in the production of world knowledge. This and several other resources can be used to overcome the systemic threat to sustainable world development, considered in this study.

5 DISCUSSION

We formulated the differential equation of demographic dynamics using the linear dependence of GDP per capita on the population size, as proposed in previous studies. However, we later revisited this dependence and showed that it is more accurate to use the exponent of 1.25. But, with a fractional indicator, the equation has no analytical solutions; therefore, the system characteristics of the solution are not so obvious. At the same time, the solution obtained is in good agreement with the statistical data. In the future, a more complex parameterization of the equation of demographic dynamics can be considered, although the main errors are not made by this assumption, but by the influence of world wars and other cataclysms. The paradox consists in the fact that fears have traditionally [6], [14], [15] been caused by the growth of the Earth's population, leading to overloading the natural environment, depleting its resources and ability to self-recover. This study shows the possibility of the opposite threat of the humanity development stagnation in the nearest future. Further efforts should be focused on understanding, which one of these threats is more critical.

6 CONCLUSION

We developed mathematical models describing the system of world dynamics with account of the interrelated processes of demographic transition, knowledge growth, and GDP dynamics. The conducted analysis of the challenges to sustainable world development associated with the evolution of humanity showed that a dramatic slowdown of the global GDP growth as a result of demographic transition and the limitation of the maximum population of the Earth at N_{max} = 11 billion people poses a serious threat. The maximum value of GDP per capita at purchasing power parity will be able to increase 3.2 times at most, compared to the current level, and will not exceed 54.5 thousand international dollars of 2017 at PP. The second risk is a dramatic slowdown in the knowledge growth, also associated with demographic transition and the limited nature of N_{max}. This phenomenon can lead to a radical change in the cognitive and innovative activities of humanity. Against the background of these processes, conflicts between various countries may ramp up, aggravated by economic crises, posing a serious global threat in the conditions of rapidly increasing countries' level of armaments.

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Shades of Green: Differences in Green Growth Priorities

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Abstract

Today the main goal of the macroeconomic policy is to ensure sustainable development. The main direction of its achievement is an orientation to the "green" vector of development. All participants in the world economy, depending on their level of socio-economic development, differently determine the goals and objectives of the transition to green growth. This fact led to the identification of three strategies to form a model of sustainable development: progressive, egocentric and deterrent. For each of them, priority directions of development are identified. Some of these directions are opportunistic in nature, others direction is caused by forced adaptation to existing global realities and internal problems, and the third direction are determined by the need to overcome internal macroeconomic contradictions, which are barriers to the transition to a green economy. It has been proven that the lack of common priorities and goals for achieving “green” growth leads to the “blocking effect” of all effective international initiatives in this area. All these trends can lead to unpredictable negative consequences.

Keywords: green economy, sustainable development, green growth strategies.

1 INTRODUCTION

It is obvious to the whole world that global sustainability can be achieved only through the transition to a green economy. The development and comprehensive support of innovative “green” projects will help to solve global problems of humanity. The environmental factor becomes the key to solving the strategic tasks facing society. However, the problem lies in the fact that each participant in the world economy understands sustainable growth and a green economy in its own way, often adhering to opportunistic behaviour without regard for the interests of other actors of the world community and not thinking about future consequences.

1.1 Differences in ways to achieve sustainable development

A green economy is often associated with the concept of sustainable development. This concept is understood as a transition to equilibrium environmental management, combining the principles of eco-efficiency and eco-justice. Within the framework of this concept, the environmental factor is considered as a key indicator contributing to the achievement of high rates of economic growth and allowing to solve contradictions between the interests of modern and future generations. There are three different approaches to the implementation of this concept.

The first approach is anthropocentric. It is based on an economic person who sets environmental quality requirements and develops rational rules for using natural resources for satisfaction social needs [15; 18]. For implementation of this approach all countries need to conduct economic activities within the capacity of their ecosystems with a gradual transition to "green" technologies that ensure the preservation of the natural capital of nations; renewing or replacing the necessary natural resources; development and preservation of the environment; reducing the gap in the level and quality of life of the peoples of the world. The anthropocentric approach is impossible without the use of environmental-economic instruments at the state level. They perform the function of a regulator when the standards of environmental pollution. However, this approach does not take into account that economic actors coordinating environmental policy may adopt inefficient rules for the preservation of the biosphere and the reduction of the environmental intensity of individual countries and all participants in the global economy These errors or targeted decisions made to satisfy the selfish interests of individual participants in the global market can be fatal to all of humanity.

The second approach is eco-centric. The basis of this approach is nature, and man is one of its types, which must adapt to the state of the biosphere and obey its laws. The economic development of mankind within the framework of this strategy is considered as a regularity of the evolutionary

development of nature. Sustainable development is impossible with a decrease in natural capital, i.e. the replacement of primary natural capital with artificial capital should be minimal [4; 6]. There is another concept within this approach. This is the theory of biotic regulation and environmental stabilization [7]. This theory is based on the “one percent rule”, which means that in energy terms the share of the possible consumption of net primary production should not exceed 1%. This is the limit of stability of the biosphere in relation to anthropogenic impact. The disadvantage of this approach is the impossibility of achieving economic growth in its implementation. Reducing resource consumption while simultaneously increasing the global population will exacerbate the existing global problems and the emergence of new social disasters.

The third approach is balanced. It is based on a combination of a balanced rate of economic growth with the rate of reproduction of natural resources and the rate of reproduction of the environment, taking into account the potential of nature. The assessment of the balance is a comparison of the ecological technological intensity of the territory with the environmental capacity of production of the territory [9; 10].

1.2 Problems of implementation of "green" projects with the help of "green" financial instruments

The green economy is viewed in conjunction with the flow of investment in green projects. Bobylev S.N. and Rubtsov B.B. [2; 20] clearly show this relationship in their works (Fig. 1).

Table 1. - Types of "green" financial instruments and options for "green" projects implemented with their help.

№	"Green" financial instruments by large groups	Types of green financial instruments	Options for green projects
1.	Retail Finance	Green mortgage; "Green" loan secured by housing; "Green" loan for commercial construction; Green loan; Green credit cards	"Green" buildings and structures (active and passive houses) (energy-saving technologies in the construction and architecture); land management (urban forests and parks).
2.	Investment finance	financing green projects; Green asset securitization; Green venture capital and private equity funds; technological leasing; carbon finance.	clean transport (alternative fuels, public transport development, hybrid / electric cars; water management (water purification, saving water consumption, rainwater use, etc.); disposal of garbage and waste products using, production of self-decaying packaging; organic farming
3.	Asset management	carbon and environmental funds; reserve funds; catastrophic bonds; environmental ETF.	renewable energy sources (solar, wind, biofuel, etc.); reforestation, soil restoration.
4.	Eco-insurance	car insurance; carbon insurance; emergency insurance; Green insurance	Eco-insurance of offshore projects; compensation of damage to victims of environmental pollution (environmental disasters).

If we examine these financial instruments more detail, it becomes clear that they are no different from the already existing counterparts, only the area of their application changes. These instruments are highly risky due to the high share of uncertainty and the probability of their loss. For this reason, the main part of such “green” projects is implemented at the expense of state support. Accordingly, each country independently develops its own individual model of financing sustainable growth [1].

1.3 Differentiation in understanding of the goals and objectives of the "green" economy by countries with different levels of socio-economic development

Third, the goals and objectives of the green economy are differentiated depending on the level of the socio-economic development of the region. For developed countries, a “green” economy is an important means of increasing the competitiveness of products, as well as the possibility of increasing the level of employment of the population, improving the quality and life expectancy of citizens through the production of environmentally pure food products. [12]. For developing countries and countries with economies in transition, the green economy is an opportunity for sustainable growth. This circumstance allows them to solve the problem of high-income differentiation of the population, the problem of poverty, and ensures the inflow of foreign investments in environmental projects implemented in these countries. [3; 8]. BRICS countries are allocated separately. For them, the main objectives of the "green" economy are associated with the efficient use of existing deposits of natural resources. It should be noted that in the official documents of any of the listed groups of countries under the objectives of the "green" economy do not specify the solution of environmental problems and the definition of environmental limitations of economic growth. This fact proves that, as before, the focus is not on global environmental problems, but on the problems of regional economic development.

2 METHODOLOGY

The following general scientific methods were used in the research: a content analysis method intended for analysing the semantic content of text arrays and communicative correspondence products on the subject of the research, as well as tools for inductive and deductive analysis, which made it possible to combine individual conclusions of the authors on this issue and to formulate the author's vision of the problem. In the process of research, special methods were also used: absolute and relative statistical indicators, dynamics indicators, methods of visualization of research results. When constructing and describing models, the authors tried to adhere to the principles of an integrated approach, which allows to establish the most significant interrelations and trends of phenomena and processes of the “green” economy and formalize the most significant effects.

The information base of the study consisted of official statistical and analytical materials of the Organization of Economic Cooperation and Development, the World Bank, and Organization of the United Nations.

3 RESULTS

The analysis makes it possible to identify three existing strategies for a model of sustainable development, considering the transition to a green economy.

The first strategy is progressive. It is based on a qualitative change in production and consumption. European countries and new industrial countries of the first wave are trying to implement it. They are implementing projects aimed at the development of renewable energy, ecological agriculture, eco-tourism, the preservation of genetic animal resources, the development of "sustainable" urbanization, etc. This is the strategy for the future. Only its implementation gives an optimistic forecast for the future existence of mankind.

The second strategy is egocentric. It is based on the implementation of the policy of double standards. On the one hand, the representatives of this strategy proclaim the principles of restricting world production and changing its structure, and on the other hand, these restrictions are implemented without their participation. Own economic interests are paramount, everything else is not taken into account. This strategy is followed by the United States because:

1. The United States refused to sign a convention on the conservation of biological diversity.

3. The United States also takes a tough stance on the problems of the transfer to developed countries of new technologies (including innovative "green" technologies), which could significantly reduce the severity of environmental problems in developing regions.

2. The United States also refused to sign an agreement on carbon dioxide emissions. Quota allocation of CO_2 emissions primarily concerns the United States because they consume the most energy and make the largest contribution to atmospheric pollution by greenhouse gases.

3. The United States took the initiative to prepare for the preservation of the forest of the planet. First, tropical forests. Developing countries perceived this as an attempt by the United States to shift responsibility for stabilizing the situation and subsequently reducing carbon dioxide to them.

4. The United States actively promotes the production of shale oil, which causes irreparable damage to the biosphere.

China can also be attributed to the representatives of this strategy. His position is determined by the need for survival. It is impossible to feed almost 1.4 billion people only through the implementation of "green" business projects, many of which are high-risk or turn out to be unprofitable.

The third strategy is deterrent. Russia adheres to this strategy. Its essence lies in the fact that now Russian economy has not reached the level of maturity for the transition to the "green" vector of development. Another limiting factor is that the economic interests of a narrow stratum of economic entities prevail over the possibility of building a model of economic development aimed at green growth. This is due to the following reasons:

1) the Russian economy is not diversified and is based mainly on the export of natural resources. Almost all large business is concentrated in the extractive industries of the economy, because it gets the opportunity to assign natural rent here.

2) economic tariffs for environmental pollution have become an institutional trap. The costs of economic entities associated with environmental pollution (the purchase of permits and emission allowances) are lower than their costs for environmental activities. These groups of market participants receive their share of distributional benefits from the existing formal rules. This circumstance leads to a “blocking effect” of achieving sustainable development of the Russian economy through “green” growth.

3) monopolism in the field of public utilities leads to the indifference of the industry to the existing problem. If the level of pollution rises, so housing and communal services rates are also increasing, which means that the profit of organizations in this sector of the economy will also increase.

4) There are a lot of towns with a single city-forming enterprise of the extractive industry in Russia. The entire economy of such city’s rests on them. Ecology issues fade into the background here, the main thing is the availability of jobs. The population is forced to adapt to this situation.

Now, the situation has improved slightly, because big business has begun to enter international markets, where considerable attention is paid to image costs for financing environmental projects.

4 CONCLUSIONS

As a result of the study, it can be noted that now the anthropocentric approach to the achievement of sustainable economic development by countries prevails. It is based on the internalization of negative externalities with the help of environmental and economic instruments that perform a regulatory function and correct market failures. Despite the unequivocal understanding by all participants of the world economy of the importance of the environmental factor in achieving economic growth and ensuring a decent future for the population, almost all global market actors have their own vision of a strategy for transition to green growth. Now, there are three variants of such strategies: progressive, egocentric and deterrent. Each of them has different priorities and goals due to opportunism; the need for survival; lack of readiness to introduce innovative technologies due to the fact that the level of economic development does not meet the required criteria, the desire to move to a qualitatively new level of production and consumption due to the development of "green" technologies.

This circumstance entails the “blocking effect” of all effective international initiatives to achieve green growth, which can lead to global environmental, economic and social disasters.

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Investing "Green" Economy in Russia

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Abstract

The authors consider the existing financial opportunities and tools used to Finance the "green" economy. The analysis of the main world results achieved in the field of "green" investment is made. The structural analysis of Russian companies from the standpoint of the availability of investment in "green" projects has been carried out. The preconditions and measures aimed at developing the market of "green" Finance in Russia are revealed.

Keywords: green economy, green Finance, green investment, green lending.

1 INTRODUCTION

The discussion of the "green" economy is not a novelty for Russia, but due to the relative novelty of this issue, there are several little considered issues in this regard.

The financial opportunities that exist in the world for the development of "green" sectors, but in which Russia today is practically not represented now, are as follows:

-Network renewable energy–6 trillion dollars In the US until 2040;

- Isolated RES – 25 trillion dollars USA in 2025;

-"Green" buildings - 300 billion USA dollars annually;

-Investments in green transport will increase to 900 billion USA dollars a year by 2025;

-Investments in water treatment infrastructure - 13 trillion dollars USA by 2030 [1].

2 THE MAIN INTERNATIONAL RESULTS IN THE FIELD OF "GREEN" FINANCE

Let us outline the main international results in the field of "green" Finance. First of all, the positions of sustainable development and "green" investments are moving from the national level to the corporate one. The most significant projects in the field of "green" investment are:

-The international coalition for an environmentally responsible economy (1989) focuses on mobilizing investors and the business community to create a sustainable environmental economy. The coalition brings together 146 institutional investors.

-Global reporting initiative (1997) development of a sustainable development reporting standard. The standard has a list of specific indicators for reporting on social, environmental and economic activities of enterprises.

-UN global compact (1999) – this initiative is aimed at promoting sustainable economic growth and increasing the level of environmental responsibility of business. As of August 2018, the initiative was supported by 13,270 companies from 166 countries.

-Network of Central banks and financial Supervisory agencies for the development of "green" financing (2017) was established with the aim of concentrating capital for the development of the environment, is also implementing a climate risk management in the financial market.

-The included development index (2018) covers 12 indicators, created to provide comprehensive information on the sustainable economic development of countries.

-The international initiative "Green bonds" (2018). Its participants position the implementation of projects with a focus on sustainable development, considering the preservation of the environment, commit to Finance their projects with the help of "green" bonds [2].

Analysis of trends in the world economy and assessment of the volume of the market of "green" Finance, existing now allow us to consider the possibility of a decent existence of the green bond market in Russia. However, for the development of the "green" Finance market in Russia, such issues as the development of a common terminology in the field of responsible financing, regulatory procedures are of fundamental importance, there is no single policy of the state in the field of "green" economy, "green" development and, accordingly, "green" Finance.[1]

3 PROBLEM STATEMENT

Despite the matured need to activate "green" Finance in Russia, there is a lack of clear criteria for the transition from the model of economic development currently used in Russia to the model of "green" economy, providing the economy with green Finance. [3] Legislative changes regarding the best available technologies are only part of a sustainable and natural economy, it is necessary to develop the methodological basis for the development of "green" Finance. The experience of placing the first green bond issue in Russia has shown that there is a clear analysis of the activities of rating agencies in this direction, however, they do not have competence in the field of assessment of climate and environmental effects. There is also an inverse relationship: those who can calculate environmental and climatic effects do not have the skills to assess financial risks.

4 RESEARCH

According to the results of the research in the field of green investment in Russia, the companies were divided into 4 groups:

1. The first group - the companies that provided information on their websites on their "green" investment projects, by economic activities, the data are as follows: 28% were companies in the electricity sector, 14.29% were in the chemical and petrochemical industries, telecommunications and communications, engineering, oil and gas industry and the banking sector.

2. This group consists of companies investing in environmental measures aimed at minimizing the negative impact on the environment. In this group, 16.67% of the projects were in ferrous metallurgy, 15% received oil and gas industry, 13.33% - chemical and petrochemical industry, 10% was electric power, food industry nonferrous metallurgy - 6.67% for each direction, 3.33% - engineering, industrial and infrastructure production, precious metals and diamonds industry telecommunications and communications transport and logistics, the coal industry accounted for 8.33% and 1.67% accounted for the forest, woodworking, engineering, wholesale, retail, energy asset management, pharmaceutical industry.

3. The third group consisted of companies that do not provide specific information on their projects on their websites but position the implementation of environmental measures or focus on the introduction of principles of environmental risk accounting in their activities.

4. This group includes those companies that do not associate their activities today (based on information on official websites) with the implementation of "green" projects and "green" financing. Structurally, these companies are located in the group as follows: engineering - 17.86%, wholesale trade and oil and gas industry - 10.71% each, electricity, chemical and petrochemical industry, transport and logistics, retail trade, engineering – 7.14% for each activity, ferrous and nonferrous metallurgy, service companies, construction, housing and communal services, agro-industrial complex banks – 3.57%.

The final conclusion based on the results of this analysis is that 62.5% of the total number of companies studied in Russia do not consider the possibility of implementing "green" projects and processes of "green" financing(group 4), 10.6% - only declare "green" positions (group 3), 24% of companies carry out "green" investment in environmental activities (group 2), and only 2.7% of companies (group 1) can be fully attributed to "green".[4]

Noting a certain readiness of the Russian business community to move to the position of "green" investment, today the Bank of Russia forms the basic elements necessary for the formation of the market of "green" Finance. Since the pilot issue of green bonds has shown good results, special

emphasis is placed on this instrument. A preliminary independent external evaluation of the green bond issue by issuers voluntarily is recommended. The examination assesses the compliance of the planned issue of "green" bonds with the standards of climate bonds, the standards of "green" bonds, it allows to assess the risks and the target nature of investment.

It should also be noted that a "Road map" has been created, which aims to create a market for "green" Finance. The main activities are as follows:

1. Development of the ideology and concept of regulatory bodies at the national level

2. Formation of a methodological centre for management in the field of "green" Finance

3. Formation and approval of principles, standards and taxonomy.

4. Development of a system for verification of "green" financial instruments.

5. Formation and development of green Finance market infrastructure.

6. Creation and promotion of a system of state support measures for green bonds. [2]

5 RESULTS

The inevitability of state regulation of green economy and development of green financing is obvious. Financing of the "green" economy should be carried out by the business itself. The task of the state is to create and use stimulating tools for the development of "green" industries, discouraging projects that do not fall under the green priorities. [5]

The best world practices existing in the field of application of the developed mechanisms of state support of "green" investment are as follows:

- application of environmental taxes and charges on a differentiated scale - with increased coefficients for those activities that are classified as "carbon-intensive" and benefits for representatives of "green" business

- weighted system of electricity tariffs;

-availability of direct state financing of investments in "green" projects;

-availability of direct state lending to business,

- subsidizing by the state to green business structures of a certain share of the costs of those loans that provide for the implementation of "green" projects,

- subsidies to credit institutions part of the loans to the green projects from the state.

It should also be noted the widespread use of market instruments of green Finance in the world practice:

- "green" banking. For banks, lending to green projects is part of socially responsible investment.

- "green" bonds. These instruments demonstrate active growth in Europe, which confirms the possibility of their application in Russian practice.

- "green" certificate. Certificates are present both in documentary and electronic form. Act as the subject of sale between several parties. [6]

6 FINAL CONCLUSION

According to experts, investments in the production of green energy create three times more jobs than the same funds invested in the development of energy based on fossil fuels. In Russia, there is a need to create a single methodological center, which will be able to combine both economic competence and consideration of ESG-factors, in order to achieve two General goals of society – stable economic growth to prevent the increasing degradation of the natural environment of the planet, to achieve harmony between man and nature. [7]

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The Role of Environmental Tourism in the System of Environmental and Economic Innovation Development of the Russian Federation

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Abstract

The problem of developing eco-tourism is multidimensional and requires detailed study. Given the rich natural resources, Russia is promising for the development of domestic and inbound tourism, including environmental tourism. The successful development of which depends largely on the effectiveness of its promotion on the market as a tourist product, that is, on targeted tourist marketing. The article analyzes the approaches in terminology, analyzes the current state of ecological tourism in Russia, reveals the relationship and prospects for its development, identifies constraints for its development, and assesses opportunities for the development of ecotourism in Russia. Ecotourism as an element of the market can serve the environmental, socio-cultural and economic interests of a person, society and the state.

Keywords: tourism industry, ecological tourism, innovative development, environment.

1 INTRODUCTION

In 2004, the World Tourism Organization formulated the concept of sustainable tourism development. The continuous process of sustainable tourism development requires monitoring the impact on the environment and taking preventive measures [1]. This was a prerequisite for the emergence of such nature-oriented tourism as ecological. The problem of developing eco-tourism is multidimensional and requires detailed study. Russia is a country with a unique vast natural area, which has the opportunity to develop this type of tourism. The UNESCO World Heritage List includes five Russian natural sites: Kamchatka volcanoes, virgin Komi forests, Altai Mountains, Lake Baikal, the Western Caucasus. It is in these regions that ecotourism can play an environmental role, contribute to the growth of employment and socio-economic development. In addition to these places, in the Russian Federation there are plenty of other areas that are attractive from the point of view of ecotourism: in north-western Russia - in Karelia, Arkhangelsk and Murmansk regions; in Central Russia, the Central Forest State Biosphere Reserve in the Tver Region in the Valdai Hills; Lake Seliger; in the western part - a national park on the Curonian Spit in the Kaliningrad region; in the south - Astrakhan Biosphere State Reserve; the unique natural resources of the North Caucasus; in Siberia - Gorny Altai, Gornaya Shoria, Kuznetsk Alatau, Western and Eastern Sayans, in the Far East - Primorsky and Khabarovsk Territories [2]. But Russia does not occupy a leading position on ecotourism among other countries, even though it has a rich natural potential, cultural monuments, incredible tourist sites and national reserves. The roots of the problems lie in the lack of motivation, desire and, of course, financing, which significantly reduces the chances of our country to be among the countries where ecotourism is well developed. Successful development of eco-tourism in Russia depends on the effectiveness of its promotion in the market as a tourist product. Integration into a single federal strategic policy for the development of ecotourism becomes problematic because of the independent processes in certain regions of Russia, which significantly slows down the socio-economic development of the regions and hinders the preservation of their natural balance.

2 METHODOLOGY

The relevance of the study is related to the position of eco-tourism as one of the promisingly developing industry in the economic component of developed countries. One of the fundamental aspects of tourism development are recreational resources of the territory. Russia, in turn, occupies one of the leading places in the world in terms of the number of recreational resources. The potential for the development of tourism in the country is great, but not used, creating negative consequences. This creates so-called "opportunity costs" (the cost of lost opportunities). The object of the research is a kind of socially responsible tourism – ecological tourism. The purpose of the study is to analyze the

characteristics of the organization of ecological tourism in terms of existing international experience in the context of globalization in Russia. Historical-geographical, comparative-geographical, descriptive methods were used as the methodological basis of the research. Problems of tourism development, in the form of weak developing eco-tourism in Russia, and, consequently, insufficiently strong involvement of the industry in shaping the country's environmental and economic well-being, are often raised in scientific papers and articles, moreover - mentioned in speeches by Russian political leaders [3]. The great potential for the development of ecological tourism is the territory of the Russian Federation with a unique nature, its diversity, attractiveness of untouched places, vast landscapes that have not yet managed to cover urbanization and processes of intensive agricultural production. Its vast ecosystem allows developing ecological tourism in many national parks and reserves of Russia, which are successfully striving to develop new and modern forms of ecological tourism. In Russia, there are regions with extensive farm types that are of great ecological value for the expansion of ecotourism in the specially protected areas of the Russian Federation. Such a country as Russia, endowed with a unique and truly unique heritage, regional diversity of nature management traditions and cultures, a reserve of "original" tourist movement in the new century can develop and become one of the leading countries in the world for the organization of ecological tourism. But for a start, you need to create the right strategy, allowing you to organize a competent transition to environmentally oriented environmental management policies and environmentally sustainable development of regions [4]. For the formation of ecotourism routes, a methodology for assessing the ecotourism potential of territories is necessary. This methodology should be adapted to the peculiarities of the protected mode and methods of managing ecotourism in protected areas. To create such a methodology, it is necessary to determine the classification characteristics of the assessment of the potential of ecotourism. E.A. Kotlyarov unites them into three groups: primary, including natural conditions and resources; secondary, including socio-cultural conditions and resources; restrictive conditions [5]. The methodology requires the adaptation of criteria for assessing the tourist potential of environmentally oriented natural objects located in the country.

3 RESULTS

Despite the fact that on the territory of Russia there is experience in implementing projects of various types of eco-tourism, but as an formed case, this idea has not yet been formed. Basically, there are regional projects that are little known at the federal level. Based on the experience that exists in the world, tourism industry enthusiasts have begun work on the implementation of the idea of creating a market for ecological tourism in the Russian Federation. In accordance with the Federal Law of the Russian Federation "On Specially Protected Natural Territories", the development of ecological tourism is among the main tasks of the national parks of Russia, as environmental protection and environmental education institutions. In a certain way, this issue is regulated by the current regulatory framework. Decree of the Government of the Russian Federation of August 3, 1996 No. 926 approved the Regulation on the procedure for leasing land, natural objects, buildings and structures on the territories of national parks for carrying out activities to ensure regulated tourism and recreation. According to this Regulation, land plots and natural objects that are in the use (possession) of national parks can be provided for rent, and the transfer of which to the lease is allowed by the legislation of the Russian Federation. Leasing of buildings and structures is carried out in accordance with the requirements of the Civil Code of the Russian Federation. The provision of land plots and natural objects for rent for purposes related to the provision of regulated tourism and recreation can be carried out for a period of up to 50 years. Land plots, natural objects are provided for rent by the results of a competition or auction. If, at the end of the deadline for applying for participation in a contest or auction, one application was submitted to the National Park Directorate, the lease agreement may be concluded in the course of negotiations between the applicant and the Park Directorate. Only legal entities and individuals who are licensed to carry out activities to ensure regulated tourism in the national park and submit project documentation for all types of work that is covered by this license can participate in a tender or auction. Project documentation is developed at the expense of participants in the competition or auction. The winner of the competition or auction has the right to conclude a lease agreement with the national park [6]. Subleasing land plots, natural objects, buildings and structures on the territory of the national park and transferring by the tenant of their rights and obligations under the lease agreement to another person (transfer), granting the leased property for free use, as well as transferring the lease rights as a pledge and contributing them in the authorized capital of business partnerships and companies or a share in a production cooperative are not allowed. The size of the rent for the use of land, natural objects is determined by agreement of the parties, but not lower than the basic amount of the rent, established by the relevant executive authorities when renting land in

state or municipal ownership. Incomes received from the rent for the use of a land plot or a natural object remain fully at the disposal of national parks and are spent by them for environmental purposes. At the same time, the national park pays land tax on the area of land plots leased in accordance with the established procedure. Speaking about the interest shown by tourists to nature-oriented tours, according to the estimate given in the report of the World Economic Forum on the demand for nature tourism, Russia still holds 73rd place in the world. According to the Director General of the Center for Ecological Travel, in the structure of the tourist flow, there is now an increasing interest in this type of tourism, which began in 2016. This center has reached a level of work with foreign tourists, which was observed only in the 90s. But at the same time, domestic demand for environmental tours, on the contrary, shows a downward trend. It should be noted that the popularity rating among Russian environmental zones, compiled by Mindscan, a company specializing in media and social media monitoring, revealed that in 2017, which was declared the "Year of Ecology" in Russia, interest in environmental zones in Russia increased significantly. If in 2016 the average number of mentions per month was 11,188 in the media and 24,729 in social networks, in January 2017 this figure was 15,584 and 29,547, respectively. The main reasons for the low popularity of environmental tours among Russian tourists, as well as visits to specially protected natural areas include:

– the almost complete lack of information about ecological tourism and about the possibilities of specially protected natural territories as tourist destinations;

underdevelopment of necessary infrastructure.

A prerequisite for the implementation of eco-tourism should be:

presence of relatively untouched natural and original cultural landscapes;

respect for ecosystems;

assistance in the implementation of environmental projects;

improvement of the welfare of the local population.

Ecotourism is a form of responsible tourism when traveling on the nature and contributes to the protection of the environment and the preservation of the welfare of the local population. It is designed for traveling in small groups in non-mass places. Ecotourism differs from nature tourism by the obligation to preserve the environment and to develop regions.

Ecological tourism programs that have been active for several years in Russia:

– environmental projects for the protection of Lake Baikal, implemented in the form of summer camps in nature reserves and national parks on the lake: "The Great Baikal Trail": the project "Save Baikal", "In the Wilds of Khamar-Dabana"; "Zapovedniy Ostrov", "To the Taiga Territory of the Baikal Region", "The Land of the Barguzin Sable", the Camp "Baikal Coast Guard Service", "On the Banks of Enchanted Ina", "Stars of Balan-Tamura", "Giants of Siberian Taiga", "Valley of Shumilikha" , "Sunny Beach" and many others;

– an environmental project implemented in the Pribaikalsky district of Buryatia "Preserve Baikal", whose main goal is the development of fishing sports and tourism in the region;

– environmental projects in the framework of the worldwide volunteer campaign "Let's Do It! World Clean Up";

– ecological projects within the framework of the national park "Ergaki" - eco-trails "Path to the Raduzhnoe Lake", "Path to the Svetloe Lake", "Stone Town", "Path of the Siberian Hunter";

– Volunteer programs of the Ecological and Educational Center "Reserves";

– environmental projects of the Volunteer Center "Chipmunk" in Moscow [7].

Starting the classification of ecological tourist routes, it is advisable to calculate the potential capacity for sustainable development of tourism in the region. When calculating the throughput of visitors, it is necessary to consider three levels: physical, real and effective throughput. Routes need to be certified and regularly monitored routes and an annual assessment of the negative impact of tourism on local natural resources should be made. Analyzing the conformity of tourist areas with the requirements of ecotourism in Russian conditions, it is advisable to be guided by the following features: diversity of climatic conditions, biodiversity, attractiveness of landscape elements, recreational opportunities, cultural traditions of the local population, natural monuments.

4 DISCUSSION

Although the results of scientific research in the field of ecotourism are published, there is still no universal understanding of the term “eco-tourism” among scientists. Opinions of domestic and foreign researchers differ in their views on the conceptual definition of ecotourism activity. Questions of the study of ecological tourism are reflected in the works of such domestic scientists as L.I. Egorenkov, A.S. Kuskov, E.U. Ledovskikh, N.V. Moraleva, E.I. Arseneva, OG Omarova, E.N. Bukhova, T. V. Bochkareva, V. A. Drozdov, G.I. Gladkevich, I.N. Panov, V.B. Pozdneev, A.V. Reznikova, T. K. Sergeeva, G. A. Sorokina, V. B. Stepanitsky, N. V. Feoktistova, V. V. Khrabovchenko, V. P. Chizhova, A. I. Eitingon [8]. Foreign scientific schools of ecological tourism differ sharply from Russian ones. The concept of eco-tourism is reflected in the works of the following researchers: P. Wight, N. Ward, D. Western, D. McLaren, P. Hasslacher, K. Ziffer, G. Wallace, W. Strasdas, D. Kramer, K-H. Rochlitz, P. Valentine, B. Steck, I. Mose, T. Whelan, D. Hawking, K. Lindberg, P. Jonsson, Epler Wood, J. Krippendorf, E. Boo, H. Ceballos-Lascurain [9]. There are four academic schools that stand out clearly - American, Australian, German and Mexican. The most correct interpretation of this term, in our opinion, is as follows: "Ecotourism is environmentally responsible trips to relatively undisturbed natural areas in order to explore and study nature and associated cultural attractions that contribute to the preservation of the environment, causing minimal damage to nature and creating socio-economic benefits for the local population through their active involvement in the tourism process" [10]. In 1996, this wording was approved by the International Union for Conservation of Nature. This interpretation gives an idea of tourism compatible with social and environmental requirements [11]. Summarizing the results of the analysis of domestic and foreign authors on the definition of the content of the concept of ecotourism, we can formulate it as follows: it is a nature-oriented type of tourism, which is designed to harmonize the relationship between man and the environment, an important function of which is environmental education and education. Ecotourism is a special form of tourism, due to the tourist visiting relatively natural areas untouched by humans in order to explore the area or rest. Also, eco-tourism has a second, important definition, since even at the present stage of development of tourist activities, researchers could not give an exact wording. Ecotourism is a tourist activity that draws attention to the need to protect the environment and natural resources and promotes respect for environmental law [12]. The conclusion on these two definitions, in our opinion, can be considered that ecological tourism can be characterized as a separate species in the tourism industry, aimed at protecting natural resources in order to protect the environment and its cognition. Tourism itself is considered to be a complex system that allows combining economic, social, political and ecological cultures. In the organization of tourism activities are possible changes in the environment. It should be noted that tourism is the most environmentally friendly type of nature management [13]. And from the economic side - ecological tourism is a favorable impact on the sectors of the national economy, contributes to its development by increasing the employment of the population of the regions. An important prerequisite, which is the basis for the development of eco-tourism, is the ability of a tourist to travel in places without anthropogenic pressure on nature and cultural resources. Anthropogenic load increases in parallel with the growth rate of visiting tourist-friendly places. According to research by the World Tourism Organization, in the 21st century in terms of the development of tourism activities, it becomes noticeable that contradictions are growing in meeting the demands of potential travelers and the proper use of tourism [14]. Negative factors were revealed in the fact that too many tourists come to certain places to rest. A large flow of tourists for the most part has a negative impact on natural territories and on their ecology. Now, the universal factor of visiting tourist and protected natural areas has a negative impact on tourism. This may be since the tourist areas were not ready to visit such many visiting people in order to relax [15]. If this happens to popular places for tourism, then we can assume what would happen to national parks and reserves in more unprepared conditions. The population is increasing, and the level of urbanization is increasing, this fact, in turn, has a detrimental effect on the environment. All these factors contribute to the change of the earth's shell, in which such natural changes take place as: climate warming; soil degradation; stagnation of biodiversity or even its deterioration; air, water and ground pollution; natural destruction under the influence of human activity; an increase in uncontrolled fertility, population growth, which subsequently affects social stratification; deterioration in food quality affecting human health; significant decrease in natural resources. From the above problems, it can be said that they entail global losses in the quality of natural resources that a person cannot cope with alone or within his own country [17]. In this regard, researchers from the German Council on the issue of global change, decided to highlight certain types of standard problems that tend to be repeated in several countries at once, having common features. The German Council identified three major problems and compared them with syndromes. The first syndrome is called "recycling syndrome". Under this syndrome, it is customary to perceive, so to say tourism, which entails the destruction of a territory through its improvement. That is, to get into any

national park, you need to organize transport accessibility to it. But this transport accessibility may entail the destruction of flora and fauna. The second syndrome is the “development syndrome”. An example of a development syndrome is environmental disruption of landscape areas as a result of unacceptable development programs. The third syndrome is “waste syndrome”. Waste syndrome is an uncontrolled or controlled action on wastes that are buried in a natural area. Subsequently, control over this territory is not controlled or control exists, but no one wants to clean up the area, as a result of which the waste gradually and slowly decomposes, leading to an ecological disaster and the unsuitability of the natural habitat for animals and plants. More and more countries are paying attention to the problems associated with ecology and the development of ecological tourism, without causing harm to nature in the process of landscaping national parks. In 1996, the World Tourism Organization (WTO), together with the World Travel and Tourism Council and the Green World Organization, developed the concept of sustainable development of ecological tourism in the 21st century Agenda 21 for travel and tourism industry. The very idea of development is based on Agenda 21 for Industry and Travel, a comprehensive program that was adopted by 182 government organizations at the United Nations Conference on Environment and Development on June 14, 1992. A paper addressed to governments, industry, non-governmental organizations and the media was widely distributed. After this document was adopted, it entered into force and was implemented over the next five years. Five years under the influence of this document have passed with benefit. The meetings, subsequently held in London (February 1997) and in Jakarta (November 1997), entailed the following important conclusions on the work done:

- the tourism industry has real potential to contribute to sustainable development with effective governance and sound regulation. "Agenda 21" should be widely distributed as the main document for the development of the industry, and implementation by all parties of its provisions should be encouraged;

- close cooperation is required between consumers, the public, private sectors and tourism organizations of the industry;

- it is necessary to have many systems for measuring progress towards sustainable development;

- should drive the expansion of tourism infrastructure towards sustainable tourism goals;

- environmental taxes must be fair and non-discriminatory, and funds received will be allocated to the tourism industry for environmental programs;

- education in the field of environmental protection should be strengthened, especially in educational institutions that train personnel for hotels and tourist companies;

- advertising plays an important role in encouraging consumers and forcing the industry to work on new principles. This should be realized through showing videos on airplanes and airports, publishing magazine articles for travel reading, announcements, useful tips on tickets, travel accessories and brochures containing information for vacationers;

- further seminars should be held in different regions of the world to explore the application of the "Agenda 21" principles to specific conditions, while ensuring their full implementation.

The principles of sustainable tourism development are also reflected in the Global Code of Ethics for Tourism, which was started by WTO experts back in 1997. The preamble to the document states that "representatives of the global tourism industry, delegates of states, territories, enterprises, institutions and organizations - members of the WTO, are aimed at promoting the development of responsible, sustainable and accessible tourism in the framework of the realization of the right to rest and travel while respecting the public choice of all nations and you desire to contribute to the establishment of a fair, responsible and sustainable world tourism order, which will bring benefits to all sectors of society in an open and competitive global market economy. "Problems of sustainable development are especially relevant for unique natural objects and phenomena, natural reserves involved in tourism [18]. Often, residents of the territories adjacent to such objects exist only at the expense of receipts from tourists. This is especially true for mountain areas. It was not by chance that 2002 was declared the International Year of Mountains and the International Year of Ecotourism by decision of the UN General Assembly. This opened up great opportunities for cooperation and unification of efforts of all stakeholders in achieving the maximum possible results during the two events. The idea of sustainable development was not accepted by all experts in the field of tourism industry. Most likely this was since the phrase "sustainable development" was not entirely successful, since the term "sustainable" is static, still, and the term "development" is movement, dynamics. A possible definition would be better “life development”. The main thing is that every state should correctly understand what

development means. For what it is needed: many states want to equal themselves in one area or another to another, neighboring, and vice versa - distant. This does not need to be done, since each state somehow needs its own, not like another development. The direction of the socio-economic movement of local communities is determined by the residents themselves, and not by outsiders with authority [19]. In this regard, it is necessary to consider traditions more, but not advertising messages. Formation of eco-tourism in the regions with the ability to earn extra income by maintaining the preserved cultures of life, maintaining the traditional lifestyle (production of themed souvenirs, selling unique food products, directly participating in animation performances, events and national holidays). Similarly, through the development of ecological tourism through the work and organization of the local population, the development of ecotourism is promoted by the revival of national cultures.

5 CONCLUSIONS

Thanks to its natural resources, Russia is considered by the world community as the most promising country for the development of ecological tourism. In particular, the UNWTO named ecotourism among the three priority areas for the development of domestic and inbound tourism in Russia [20]. In some regions of Russia, the development of ecological tourism is already quite active in its own ways; however, this direction should be combined into a single federal strategic policy, the objectives of which should be the socio-economic development of the regions and the preservation of their natural and ecological balance. The priority tasks of the development of ecological tourism in the country are:

– the formation of an algorithm for developing a strategy for the development of ecotourism;

– training qualified specialists for the industry;

– development of a wide range of new ecotourism products;

– use of flexible pricing policy;

– state assistance in promoting ecotourism products to the world market;

– joint work of regional authorities and the local community in the development of ecological tourism in regional specially protected natural territories;

– Attraction of domestic and foreign investments, motivating their participation, for example, by simplifying tax burdens or the desire of businesspeople to participate in the development of the region;

– improving the methodological base of ecotourism;

– modernization of tourist infrastructure;

– creation of a system for monitoring the capacity of the territories used in ecotourism;

– formation of a system for planning and controlling the effects of eco-tourism activities;

– development of schemes of interaction with local communities for inclusion in tourism activities;

– creating concept and planning other tourist services and infrastructure for ecotourists;

– improving the marketing process.

Lack of experience, lack of uniform methods for determining throughput and recreational loads, lack of information about eco-tour areas and their natural potential, insufficient number of routes developed, lack of quality advertising and developed infrastructure suggest that ecotourism as a type of tourism is in Russia in the early stage of its development. But given the rich recreational potential of the country, eco-tourism as an element of the market is a promising direction that can serve the economic, environmental, socio-cultural interests of the state and society.

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Competitive Advantages and Sustainable Development of Russian Agrarian Sector

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Abstract

The performance of Russian Agricultural Sector under international economic restrictions is a matter of concern. In this article we analyse the impact of international economic restrictions and macroeconomic factors on the output of Russian agricultural sector. We employed ARIMAX model with the time period from 1991 to 2017, using nine economic factors as covariates and agricultural value added as a dependent variable. It was found that despite on negative impact of sanctions on special aspects of Russian economy, international economic restrictions of 2014 at the end of 2017 had a significant and positive effect on the output of Russian agricultural sector.

Keywords: agricultural sector, Russian agriculture, international economic restrictions, import substitution, time series model, ARIMAX

1. INTRODUCTION

Agriculture is a branch of the economy of the country, which not only produces the most necessary products for human beings, but also is a kind of catalyst indicating the economic development of the state. Generally sustainability of the agricultural sector is a complex, open, a dynamically developing, multilevel and multi-purpose system, represented, on the one hand, by a set of structural elements, on the other — a subsystem of the macro level and the main link in the complex of measures to provide the population with food. It is based on the process of transition from one qualitative state to another under the influence of factors of internal and external environment based on economic growth. Herewith the most important properties and the ability of the system to fulfil the goals and objectives aimed primarily at a rational combination are preserved efficiency of economic activity, environmental safety and social orientation.

In the context of the current economic crisis, the importance of a comprehensive analysis of the sustainability of the agricultural sector, aimed at the positioning of its components, as well as obtaining generalized characteristics on the basis of complete and reliable information about the processes taking place in agriculture, is actualized. This is possible only through the development of a system of interrelated and complementary indicators and integrated assessment methods. However, despite the presence of undoubted scientific and practical achievements in the field of sustainable development of the agricultural sector, most of its aspects need further clarification, require further systematic study. In particular, to date, the economic science has not finally developed approaches to justify the selection of criteria and indicators that allow obtaining a reliable description of the level, direction and intensity of changes in the sustainability of the industry, methods of integrated assessment of the processes taking place in it. In 2014 international economic restrictions against Russia took effect, and Russia introduced some import restrictions regarding agro-industrial products and thereby put itself in the position of import substitution ([10], [15], [5], [8]. Events of 2014, which is attributed to international economic restrictions, to a great extent had an impact to Russian food sector, and people assess this effect in different ways. Some authors ([9], [3]) conclude that under restrictions pressure and crises, manufacturing effectiveness of agro business enterprises makes worse, but under the conditions of import substitution and, as a consequence, weakening competition and increasing government support, firms are able to occupy new niches and improve their conditions with the help of government support. Some publishers ([13], [14]) estimate sanction impact from the perspective of end-consumer. They marked that import embargo is reflected in food prices, that changes a purchasing power of population. The authors also notice that policy of import substitution allows Russia to find new trade

partners from countries suppliers in the EAEU and the CIS and decrease import dependence from Europe countries. But the emphasize that still there is no substitution for some categories of products. In recent articles [11] about Russian agriculture it has been specified that economic restrictions of 2014 allowed Russia to decrease volumes of import, raise consumption of food on average, but for low-income family's food consumption compose the highest share from total consumption.

Agricultural sector apart from sanctions is influenced by different factors [7]. The factors affecting the sector include climate and environmental management changes, science and technology improvement, demographic and social transformations, new models of economic and politic development or management system [1]. [2] and [11] analysing the growth factors in agricultural products output, focuses on the innovative activity, which from their point of view is the main factor of economic development. Therefore, they conclude that it is necessary to build up of scientific and technical potential with high share of innovation and to intensify the production process in the agro-industrial complex. Malysheva [4] considering the factors affecting the development of agriculture, organizes and groups them into the following categories: land as the main production factor in agro industry, government support as a factor of agricultural sector financing, competitiveness as a go-to-market factor, environmental conditions, scientific and technological progress and products prices.

2. METHODOLOGY

As a method of forecasting the Box–Jenkins approach was chosen, which is one of the best for analyzing and forecasting time series. This method applies two types of models, including ARMA (autoregressive moving average) and ARIMA (autoregressive integrated moving average), which helps to fit time-series model based on past values. In current research we will use extended version of ARIMA model, which is abbreviated as ARIMAX (Autoregressive Integrated Moving Average with Explanatory Variable). The method relates to technics of ARIMA model but assumes the application of additional independent factors (multivariate dataset), but not only lagged values of dependent variables and errors (univariate dataset). Other words ARIMAX refers to set of independent variables for a single dependent variable (regressor). The nature of this type of model is close to OLS estimates.

In general, ARIMAX model may be represented by the following formula:

$$y_t = \alpha + \beta \times time + \gamma * covariate + u_t \quad (1)$$

where y_t – the regressor,

$time$ – the indicator of a time period in years,

covariate – the indicator of independent variable,

u_t –residuals.

In the special case ARIMAX (p, d, q) can be represented as:

$$y_t = \gamma + \varphi_1 y_{d,t-1} + \ldots + \varphi_p y_{d,t-p} + \theta_1 u_{t-1} + \ldots + \theta_q u_{t-q} + \beta x_t + u, \quad (2)$$

where y_t – time- series component from the equation (1),

p and q –lags for AR(p) and MA(q) components,

$y_{d,t-1}, \ldots, y_{d,t-p}$ – lagged values of the time-series component differentiated d times,

ε_t – stochastic disturbance,

$u_{t-q}, \ldots, u_{t-1}$ – lagged values of the residuals' component.

3. RESULTS AND DISCUSSION

All input data are given in Table 1.

On the first step in order to check stationarity of the row we construct a plot with our dependent variable, which is agricultural value added. The result is demonstrated under.

Table 1. - Descriptive statistics for the model. Source: Rosstat, OECD, FAO, World Bank

	Aggreculture value added (constant 2010 US$)	Foreign Direct Investment	Rural population	GDP Deflator	Arable land	Area of land use	Exchange rate	Share of employment in agriculture (% of total employment)
Abbreviations	**agro_value**	**FDI**	**rur_pop**	**GDP_defl**	**arable_land**	**land_area**	**exch_rate**	**share_emp**
Unit of measure	**Value mln US$**	**Value mln US$, 2010 prices**	**thousand people**	**Value US$, 2010 prices**	**1000 ha**	**1000 ha**	**RUB/ USD**	**%**
1991	62344,13	2574,4	39292,35	41,56	132672	221631	0,00	14,24
1992	56733,16	3674,06	39356,21	42,51	132008	218795	0,04	15,42
1993	54463,84	2341,89	39368,93	43,52	129538	217711	0,35	15,56
1994	47928,18	631,35	39287,84	44,45	128422	216400	1,39	16,15
1995	44093,92	1332,94	39341,90	45,33	127500	216111	3,58	15,77
1996	41756,94	1994,14	39297,38	46,15	126024	217989	5,12	15,27
1997	42800,87	6753,81	39227,69	47,02	127466	217287	5,79	12,16
1998	34754,30	3630,16	39167,53	33,24	126132	216790	9,70	11,69
1999	40697,29	9688,83	39097,84	22,60	124975	217162	24,62	15,01
2000	45865,85	11547,94	38925,85	27,22	124374	216861	28,13	14,49
2001	51094,25	8160,29	38770,56	30,58	123860	216651	29,17	12,05
2002	52578,72	10562,27	38469,26	32,90	123465	216277	31,35	11,34
2003	51637,08	24940,44	38415,46	38,29	122559	215980	30,69	10,80
2004	52172,13	27848,97	38204,52	49,06	122146	215680	28,81	10,00
2005	52094,10	28085,58	38020,61	59,63	121781	215488	28,28	10,14
2006	53397,70	41772,53	37829,81	71,43	121574	215463	27,19	9,88
2007	53888,19	50744,32	37688,57	86,41	121574	215494	25,58	8,86
2008	56975,09	54076,21	37632,39	104,92	121649	215450	24,85	8,53
2009	57932,56	41114,85	37604,56	83,79	121750	213952	31,74	8,43
2010	50991,69	41116,46	37613,60	100,00	119000	214650	30,37	7,75
2011	58238,94	38058,81	37499,50	127,79	120000	214350	29,38	7,69
2012	57542,57	21556,14	37298,60	132,81	119750	216840	30,84	7,33
2013	60147,66	52822,32	37228,80	135,61	122240	217722	31,84	6,99
2014	61059,17	53800,4	37118,20	120,98	123122	217722	38,38	6,72
2015	62817,70	33328,3	37985,10	82,28	123122	217722	60,94	6,71
2016	64908,09	35215,26	37887,30	77,40	123122	217722	67,06	6,72
2017	65841,37	34984,6	37772,00	93,60	123122	217722	58,34	5,90

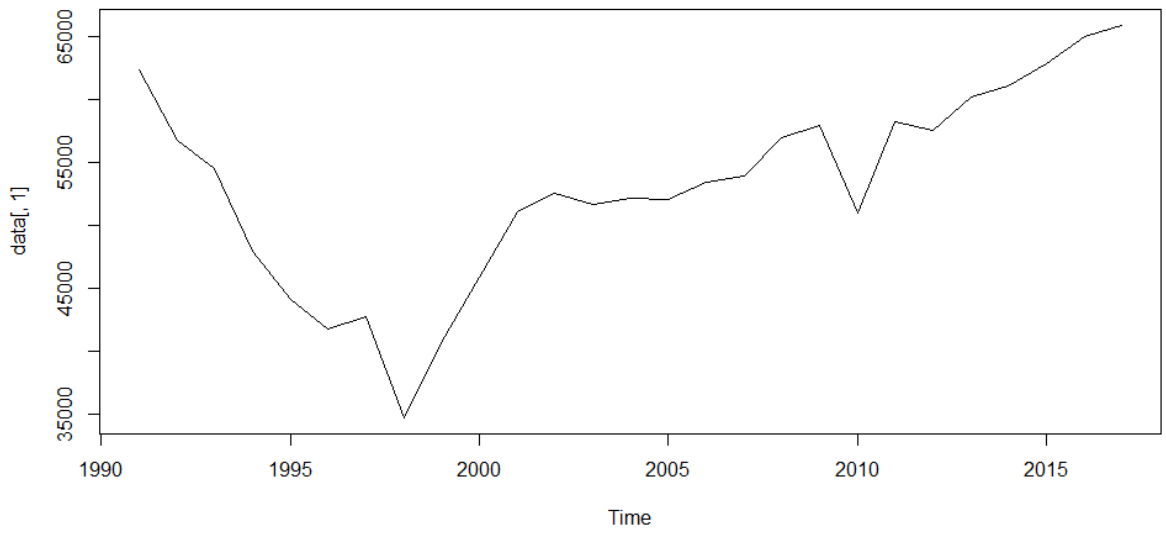

Figure 1. Graphical representation of agricultural value added from 1991 to 2017.

Source: R-Studio

In order to check stationarity, we run Dickey-Fuller test. The results of the test (p-value>0,05) and the Figure 1 testifies about non-stationarity of the row. Hence, we take first differences from all variables. Next step of the determination of model is the test on lagged variables. On this step we derive graphs of autocorrelation function and partial autocorrelations function, the results of which are represented in Appendix C. The graphs show that none of the lines cross the dashed line, this means we do not have lags in both dependent variables and residuals. The conducted tests allow us to form a model ARIMAX (0, 1, 0), where zero is devoted to absence of lag variables and one to first differences. The last step before the model estimation is diagnostics of residuals in the model. We accomplish Ljung–Box test and autocorrelation functions (ACF and PACF) and come the conclusion that stochastic component of the model appears as random noise, which means we have a good model that took all the useful information from the data. As the model shows, significant factors in the model are foreign direct investment, exchange rate (RUB/USD), agricultural support, import volume, and existence of crises and sanctions (economic restrictions). Other factors are not significant, but they should be included in the model because the explanatory power of the model has increased with their existence. With an increase in foreign direct investment by 1 million dollars, the increase in agricultural production achieves 66 thousand dollars. The relationship illustrates positive dependence of FDI and agriculture output, it means that attracting foreign direct investment has a positive effect on the state of the agro-industrial sector. With the weakening ruble by 1 ruble toward to dollar, agricultural value added on average increases by 4.5 million dollars. This relationship ratio can be explained as follows. Weakening ruble makes oil lower priced, import more expensive and export cheaper, which creates a competitive advantage to the national producer that boost the output of agrosector. At the same time import of machinery for the sector becomes costly.

We have obtained a positive correlation between sanction implementation and agricultural sector performance. The same conclusion was stated by [9], [3]. In fact, international economic restrictions of 2014 decrease number of foreign direct investments [6], in some degree it reduces consumption of fixed capital, lead to effect in exchange rate and oil price fluctuation [12] etc. At the same time international economic restrictions of 2014 allows Russia to limit import and give opportunity for the targeted country to expand local production, which has a positive effect to the sector at the end of 2017.

4. CONCLUSION

The performance of Russian agricultural sector and Russian economy after imposition of international economic restrictions in 2014 is still the topic with heightened interest especially in Russian literature. The topic stays relevance because international economic restrictions are extended until the end of 2019. In Russian articles researchers pay attention to the dynamics of agricultural production in different categories of production, changes in food prices, import and export volumes, but none of

them use econometrics or mathematical statistic tools in order to estimate the complex effect of sanctions and economic factors on the performance of the agro-industrial complex. Meanwhile in foreign researches we can observe a variety of econometric models, which allow evaluating consequences of international economic restrictions, specifically to such indicators as change of GDP, living standard of population, investments flows, level of employment etc. The results of the research match with the previous findings. Some authors also conclude that economic restriction in long run will have positive effect on the economy and agricultural sector as well.

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Modern Methods to Sustainable Development Assessment

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Abstract

The paper offers a review of evolution approaches to the sustainable development assessment in different world countries and in Russian practice. The research is based on the analysis of world practice assessment of sustainable development effectiveness, relevant methodologies, indicators and their modifications in modern conditions. The existing problems in developing of indicators for the sustainable state measuring of various countries with different development level are characterized. The difficulties of cross-country comparison of these indicators are highlighted. The most important aspects of sustainable development assessment, such as indicators and investments are considered. The main directions of sustainable development assessment for Russia are determined at the present stage of the national economy development.

Keywords: Sustainable Development of economy, sustainable development indicators, investments, modern assessment methods, etc.

1 INTRODUCTION

The priority of economic growth to the detriment of social and environmental problems solving is a fundamental disadvantage of current development model theory and practice in the world. In this regard, an active search for new solutions for the future existence is observed. In recent years, the world community has developed a development concept for the 21st century, which is based on the sustainability paradigm [1]. Especially, it becomes topical due to the limiting factor of natural resources and environmental quality. Under the leadership of the United Nations, new models of economic development are being created, the control over the Earth's natural resource potential usage is being strengthened, new approaches to sustainable development assessment are being worked out and updated, and the questions of its investment are being raised [2]. At the same time the main goal is stable improvement of current and future generations life quality.

The questions concerning to the necessity of sustainable development indicators creation were discussed at the end of the last century, in the Global program «Agenda 21». [3]. A significant contribution to such trend development in modern economics has been made by international organizations at the global and regional levels: World Bank in the framework of the World Development Report, World Trade Organization, Organization for Economic Cooperation and Development, United Nations, UN Conference on Trade and Development, UN Regional Commissions, regional banks, etc. [1].

The issues of integrated indicators development and application are discussed at almost all conferences held in the framework of sustainable development, they were also considered in the works of world leading scientists from different points of view. Thus, an international group of practitioners formulated 10 principles, based on which the indicators selection, the progress measurement, the results interpretation and transmission of the sustainable development assessment proceeds [4]. The studies of C. Kirkpatrick and N. Lee [5] focus on several issues related to sustainability assessment in developing countries and in countries with economies in transition. Many scientists also analyse the problems of choosing and using indicators for sustainable development assessment in countries with different economy levels. [6], [7].

An important issue along with the determination of sustainable development assessment indicators is their monitoring. Many papers cover the issues of integrated information collection and integrated databases creation for obtaining of a sustainable development composite index. Based on this index it will be convenient to track an integrated information on the economic, environmental and social indicators of the system of interest [8], [9]. It allows to formulate well-defined goals for sustainable development and to offer the performance measurements, both for the current time and for the long-term period.

In 2006, the Commission on Sustainable Development proposed a set of 50 key indicators offered by a group of specialists from developed and developing countries, with a detailed methodology for their calculation [10], [11]. It was positive that these indicators could be used by all countries as reference material for their own indicator systems creating adapted to national peculiar features of development.

It should be mentioned that all the authors note the emerging problems connected with indicators calculation. For developing countries, it means incompleteness or unavailability of informative data collection, for developed ones it means inconsistency and non-standardization of statistical data despite of its availability and abundance. Such challenges have a negatively effect on the procedure of high-quality information processing operation and to the statistical indicators' measurement, and in general, that makes difficulties for a cross-country comparison holding and indicators calculation of the countries' sustainable development assessment.

Along with the development of sustainability indicators' assessment, it should not go unmentioned that there is still such an important issue as investing in sustainable development.

Currently, structural changes in character and content of production processes lead to qualitative changes in fixed assets and the need for their more frequent updates. A separate problem is IT equipment disposal, because it quickly becomes obsolete and leads to funding increase for these purposes. Investments in local development for sustainability improvement cannot be compared with the scale of investments in the elimination of catastrophes and natural disasters, the number of which is increasing due to the climate changes on the planet. Soon, the planned costs on damage elimination and preventive measures should be around 32 billion $ (data was taken on the company BP website).

These trends change the distribution structure of investment resources, as well as the traditional understanding of the term "investment". Unproductive investments, which are often made under compulsion, are not aimed at income generation, but they are rather aimed at preserving and protecting of life conditions and reproduction, responding to global natural, technogenic and other threatening occurrences. It actualizes the study of individual destructive manifestations of investment processes, statistical analysis development, accounting and control at the level of international organizations considering the global tendencies.

2 METHODOLOGY

The world experience shows that the sustainable development assessment should be carried out on the principle of indicators' system building, where each indicator reflects a separate aspect of economic development. According to this approach, within the framework of the general system, subsystems of indicators are often distinguished: environmental, economic, social and institutional, and then an integral (aggregated) indicator is created on their basis.

The indicators selection, as a rule, is carried out according to the scheme proposed by the OECD [12], where 4 types of environmental indicators are highlighted: pressure (anthropogenic factor), state parameters, influence factors, reaction (necessary measures). The final list is formed from 134 types of indicators. Such several indicators complicate the work at the national level; therefore, the number of indicators is reduced in a system called "topic - subtopic - indicator" [13]. In such a system, key topics are defined initially for each area, which are detailed by subtopics, and then the data is reduced to the minimum set of indicators.

The problems of integrating indicators diverse into a single index were considered in the report of the UN Commission on Sustainable Development [13]. The main difficulty in the process of integrating information into indexes is to determine the weight contribution of the initial indicators without significance losing and without excessive subjectivity. With increase of the aggregation level of information, the complexity of incomparable quantities weighting grows, and inter-country compatibility becomes more complicated.

To identify the weight or separate indicator importance in the integral index in the social sciences, it is advisable to use the Delphi method or multi-criteria analysis. Another method called "Distance to the Goal", allows using indicators, agreed by international or other legal documents, as a desired goal. At the same time, weighting factors can be obtained both based on a public opinion polls (Eurobarometer - European Commission), or also according to the Delphi method, which is a group method (to hold an individual opinion poll of an experts' group). The public or individual polls are repeated several times and after coincurring opinions begin to appear, the results are used as an assessment.

At the same time, it is necessary to rely on various laws, international conventions, norms. Moreover, the following criteria are applied: long-term or short-term aspect, global - regional - local level of the problem, depth and complexity of the impact, irreversibility degree of the process, etc. In general, it is not recommended to focus on the same significant indicators (equal weights).

3 RESULTS

Amongst various methods which are currently available for integral indexes calculating, we have identified and considered some of them, based primarily on environmental parameters. Adjusted net national income per capita ($), calculated by the World Bank for 100 countries, including Russia [14], is quite popular nowadays.

Human Development Index developed by the Bureau which prepares Human Development Reports, which are published under the auspices of UNDP, is widely used [15].

Also, the Environmental Performance Index (EPI) is of interest. It is a method for quantitative assessment and comparative analysis for the world's countries environmental policy measurement.

The integrated indicator, which is an alternative to GDP, is the Genuine progress indicator (GPI). It's an index of economic progress, which gives more accurate assessment of sustainable economic well-being.

The aggregated Living Planet Index (LPI), which was introduced to assess the state of the planet natural ecosystems, is calculated in the framework of the annual report of the World Wildlife Fund [16].

The Environmental Sustainability Index (ESI) is also representative. It was developed by a group of scientists from Yale and Columbia Universities for the World Economic Forum in Davos in 2001. It can be noted that the index of real progress (Genuine Progress Indicators (GPI) and the index of sustainable economic well-being (Index of Sustainable Economic Welfare) [17] become an attempt to create an adequate measure of economic well-being and improve the GDP index taking into account external effects.

Table 1. Comparison of some countries on various sustainable development indicators

Country Human Development Index, 2017	Rank	Country Environmental Performance Index, 2018	Rank	Country Sustainable Development Goals, 2017	Rank	Country Adjusted net national income per capita ($), 2017	Rank	Country Gross national income, 2017	Rank
Norway	1	Switzerland	1	Sweden	1	Norway	61,95	China	1
Switzerland	2	France	2	Finland	3	USA	48,68	USA	2
Australia	3	Finland	10	Norway	4	Canada	34,93	India	3
Germany	5	Germany	13	Germany	6	Germany	34,78	Germany	5
USA	13	Norway	14	France	10	Finland	34,52	**Russia**	6
Oman	48	USA	27	USA	42	France	30,41	Brazil	7
Russia	49	Venezuela	51	Singapore	61	Argentina	11,74	Indonesia	8
Montenegro	50	**Russia**	52	**Russia**	62	Brazil	7,62	Italy	11
Brazil	79	Brunei Darussalam	53	Albania	63	**Russia**	7,31	Mexico	12
China	86	Brazil	69	China	71	China	6,09	South Korea	14
Colombia	90	China	120	Brazil	56	India	1,37	Saudi Arabia	15

Source: according to international reports [2], [14], [16], [19], [20].

Table 1 presents some of these indicators and comparisons which are made for some world countries according to 2017 and 2018.

In the world practice, many different indicators are widely used to assess the sustainable development, such as a comparison by Gross national income, or the Adjusted net national income per capita (Global Footprint Network) indicator [18] and many others.

According to the rating indicators which are presented in the table for some countries of the world, it can be noted that there are certain incompatibility problems in countries' positions comparison in terms of the aggregated indicator. If, for example, Norway occupies a leading position upon the Human Development Index in the rating of the Environmental Performance Index, but it is only 14th, in terms of sustainable development 4. Russia is far from the first positions in all ratings. The fact of irregularity is visible in other countries, for example, in Brazil. Therefore, there is a question whether it is necessary to use so many complex indicators in conducting of sustainable development assessments at the global level.

The calculations for individual countries based on various methodologies showed a huge gap between traditional economic and environmentally adjusted indicators. Thus, for many countries of the world, the situation becomes topical when in conditions of formal economic growth the environmental degradation is observed, and environmental correction can lead to a significant reduction in traditional economic indicators, up to negative values of their growth (for example, in Russia in 2000, when GDP grew by 9% “true savings” indicator was “–13%”) [18].

This makes difficulties for data comparison for countries with different development levels, inconsistencies in statistical databases, since many countries keep records differently, and some parameters are not considered at all.

The evaluation of investments in sustainable development is also difficult, since countries have different levels of economic development, and many countries often ignore this issue. Although, as it was noted, current trends in investment changes require the maintenance of new claims for investments accounting in environmental and sustainability programs. In Russia, the investment indicators in fixed assets aimed at environment protection and rational use of natural resources are reflected on the national accounts. And it should be noted that over the past 18 years, at the period of 2000-2018, a growth trend, as it is shown in Figure 1, can be observed. It indicates that Russia is actively involved in sustainable development processes and aims to participate in various programs and activities directed on living standards improvement and environment health increasing.

Russia has an experience in sustainable development indicators systems creating. Based on international methodologies, as well as on priority basic environmental-economic indicators of sustainable development (Development of indicators in the framework of a project of the World Bank and the Ministry of Economic Development of the Russian Federation for applying in Russia), a number of Russian regions have developed their own indicators in the framework of scientific research:

- Tomsk and Voronezh regions - sustainable development indicators system (the development was carried out by the British consulting firm ERM and was funded by the Department for International Development of the United Kingdom (DFID) by order of the Ministry of Economic Development and Trade of Russian Federation);

- Kemerovo region - a system of socio-economic and economic indicators, including the Integral Index of the Adapted Net (true) Savings;

- Samara region - key indicators of environmentally sustainable development;

– Millennium Development Goals (MDG) –7 (adapted for the region).

All regional systems of sustainable development indicators include the human development index, indicators reflecting the population’s incidence, the biodiversity’s preservation, people incomes’ differentiation, the renewal of fixed assets. Additional indicators reflecting the specifics of the region were included in addition to the main indicators system. Unfortunately, the use of different indicators’ systems eliminates the possibility of conducting a comparative analysis for the regions of Russia - each region developed and used its own systems to assess the development dynamics of its territory only. Also, there is no practice of the region’s comparison according to already approved basic sustainable development indicators.

4 CONCLUSIONS

It should be noted that the measurement of the development progress achievements in countries, including Russia, must constantly be explored, new measuring ways of country's state of development should be found, its development trends and opportunities should be assessed. Because Russia is a country with vast territories and significant natural potential, but with irregular socio-ecological and economic regional development, it is necessary to monitor and evaluate indicators of sustainable development at the regional level.

The creation of regional and territorial database is required. There are certain gaps here, since a number of even traditional indicators are not calculated at the regional level of the country. It is advisable to calculate the integral environmental and economic indexes annually, in particular, the Ecological Net Domestic Product and the Index of Adapted Net Savings, which are important for the national economy, since they correct traditional macroeconomic indicators by taking into account depletion of resources, including energy, and environmental pollution. It will help to make more accurate assessment of the country's national wealth.

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