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Tatar M.S.,
PhD in Economics, assoc. prof., associate professor at the finance, accounting and taxation department,
Butko M.S.,
student,
National Aerospace University "Kharkiv Aviation Institute"

TRANSFORMATION OF THE FINANCIAL MECHANISM OF AGRICULTURAL ENTERPRICES INTERACTION IN THE CONDITIONS OF GLOBAL CLIMATE CHANGE

Татар М.С.,
канд. екон. наук, доцент,
доцент кафедри фінансів, обліку і оподаткування,
Бутко М.С.,
студентка,
Національний аерокосмічний університет ім. М. Є. Жуковського «Харківський авіаційний інститут»

ТРАНСФОРМАЦІЯ ФІНАНСОВОГО МЕХАНІЗМУ СПІВРОБІТНИЦТВА АГРАРНИХ СУБ'ЄКТІВ ГОСПОДАРЮВАННЯ В УМОВАХ ГЛОБАЛЬНОЇ ЗМІНИ КЛІМАТУ

Formulation of the problem. The biggest global challenges are climate change; environmental pollution caused by human actions; loss of biodiversity; proliferation of weapons of mass destruction; spread of infectious diseases, pandemics. Since climate change occupies the first place in the TOP rating of global challenges, the analysis of the impact of this global challenge on the development of various sectors of the national economy, especially agriculture, is extremely relevant, since the level of food security depends on the development of the agricultural sector.

Analysis of recent research and publications. In modern research, the issue of climate influence is very relevant among scientists from various industries, since this topic is interdisciplinary in nature. The economic side of the impact of climate on various fields of activity was dealt with by such authors as Žutinić Đurđica, Zrakić-Sušac Magdalena [1], Karahasan Burhan Can, Pinar Mehmet [2], Padgham John [3], Prokopenko K., Udova L. [4], Shengcai Tao, Yinlong Xu, Ke Liu, Jie Pan, Shiwei Gou [5], etc.

Žutinić Đurđica, Zrakić-Sušac Magdalena determine the opinions and attitudes of agricultural advisors on climate change. Attitudes were measured using 16 statements which summarize three composite indicators (awareness of anthropogenic causes and consequences, mitigation responsibility, and indifference and defeatism towards climate change). Results of the research show that the respondents are relatively aware of the anthropogenic impact on climate change, as well as wider consequences of climate change on society and the environment (MKIs = 3.83). On average, respondents expressed strongest agreement with statements about political and civic responsibility in climate change mitigation (MKIo = 4.06). Most agricultural advisors perceive climate change as dangerous for the stability of domestic farming, and as many as 92.4% of respondents believe that farmers do not have the necessary knowledge to successfully deal with the risks of climate change in their own production [1].

Shengcai Tao, Yinlong Xu, Ke Liu, Jie Pan, Shiwei Gou propose to use such methods for the assessment of agricultural vulnerability to climate change as statistical analysis method; indicator system method; model simulation method; comprehensive evaluation method [5].

However, the determination of the impact of climate change on the agricultural products productivity and the procedure for transforming mechanisms of interaction between business entities and stakeholders at different levels of the hierarchy during countering global challenges have not been sufficiently considered.

Setting objectives. The purpose of the article is the formation of theoretical and applied principles of agricultural entities interaction in accordance with global challenges.

In order to achieve the set goal, guidelines for the construction of a financial mechanism for the business entities interaction in accordance with global challenges are determined; the impact of global climate change on the development of the agricultural sector is determined; the measures to increase the

efficiency of interaction of subjects of different hierarchical levels to counteract the negative consequences of global challenges are proposed.

Presentation of the main research material. Global climate change is one of the urgent threats to international security that disrupts the economic development of countries and has absolutely measurable financial consequences that grow every year.

Without adaptation measures, climate change could reduce global agricultural growth by up to 30% by 2050 [6].

Climate change and agricultural development are interrelated, as agriculture, which suffers from climate change, is both a source of greenhouse gas emissions and therefore one of the causes of this change.

Traditional agricultural production technologies significantly disrupt the natural balance and pollute the environment. Among the environmental problems that arise as a result of human extraction of food products of plant and animal origin, the following can be distinguished:

– contamination of soils, ground and surface water, as well as drinking water with residues of mineral fertilizers and plant protection products;

– industrial pollution during the production of agrochemicals;

– environmental pollution with animal farm waste (bacterial soil contamination, atmospheric air pollution with methane, hydrogen sulfide, ammonia);

– reduction of plant and animal species diversity;

– depletion, waterlogging, salinization of soils;

– growing shortage of water resources;

– negative impact on human health from the consumption of cultivated plants in which dangerous substances have accumulated (in particular, residues of mineral fertilizers and toxic chemicals);

– risks to human health in case of eating food products obtained from genetically modified organisms.

On the one hand, agriculture is a significant source of greenhouse gas emissions, because animal husbandry and crop production are associated with emissions of carbon dioxide, methane, and nitrous oxide. According to emissions reports that national governments regularly submit to the Secretariat of the United Nations Framework Convention on Climate Change, agriculture accounts for approximately 15% of global greenhouse gas emissions. On the other hand, greenhouse gases change the climate and thus affect agricultural production. At the same time, the share of agriculture in the world GDP is about 4%, which indicates that the carbon intensity of agriculture (emissions per unit of production) is quite high [6].

Agriculture accounts for almost half of the global emissions of the two most powerful greenhouse gases after carbon dioxide: nitrous oxide and methane. Nitric oxide is formed during microbiological and chemical transformations of organic matter, both in oxidation (nitrification) and reduction reactions (denitrification). The amount of emissions depends on the type of soil, humidity, temperature and tillage system. Methane is formed as a result of anaerobic processing of organic matter by microbes in the digestive tract of ruminants and other animals (intestinal fermentation), during storage of organic fertilizers, as well as during all transformation processes in conditions of lack of oxygen in the air.

The most important factor for a good harvest of any crop in Ukraine, with its natural (climate-wise) rather limited amount of precipitation, is sufficient soil moisture. Deficiency of soil moisture during the growing season is the main factor that reduces yield. The source of soil moisture is precipitation. The annual amount of precipitation is a general indicator of the wetting of the territory.

At the same time, the most important precipitation for all crops is precipitation during the growing season (April-October). In addition, the nature of precipitation is changing, namely, the number of inefficient heavy downpours is increasing, which often after long dry periods cause more harm than benefits.

Climate change impacts on agriculture will vary by region. Climate change impacts on subtropical and tropical regions will be predominately negative, especially where agriculture is currently marginal with respect to high-temperature and moisture-deficit conditions. The most vulnerable agricultural systems occur in arid, semi-arid, and dry sub-humid regions in the developing world, home to half of the world's malnourished populations, where high rainfall variability and recurrent droughts and floods regularly disrupt food production and where poverty is pervasive.

In Europe, climate change is expected to generate a mixture of positive and negative effects, with overall crop productivity predicted to increase from temperature rise and potentially from crop growth stimulation with increased CO_2 concentrations. In Russia, cereal yields and the overall land area suitable for agriculture could increase. However, crop-growing regions in southwestern Russia could face significant production shortfalls due to increased drought prevalence and reduced runoff, while northern Russia may experience more flooding. Southern Europe is likely to experience reduced productivity of summer crops as a result of increased heat stress, higher rainfall intensity, and longer dry spells. Production zones could shift northward for crops that are currently predominant in southern Europe, such as maize, sunflower and soybeans [3].

Climate change is shown in Fig. 1.

Europe is the region where the temperature change has been the highest in 2020 (and also for most of the 2000–2020 period), with 3.4 °C, followed by Asia (1.6 °C), Oceania (1.4 °C), the Americas and Africa (1.3 °C) [6].

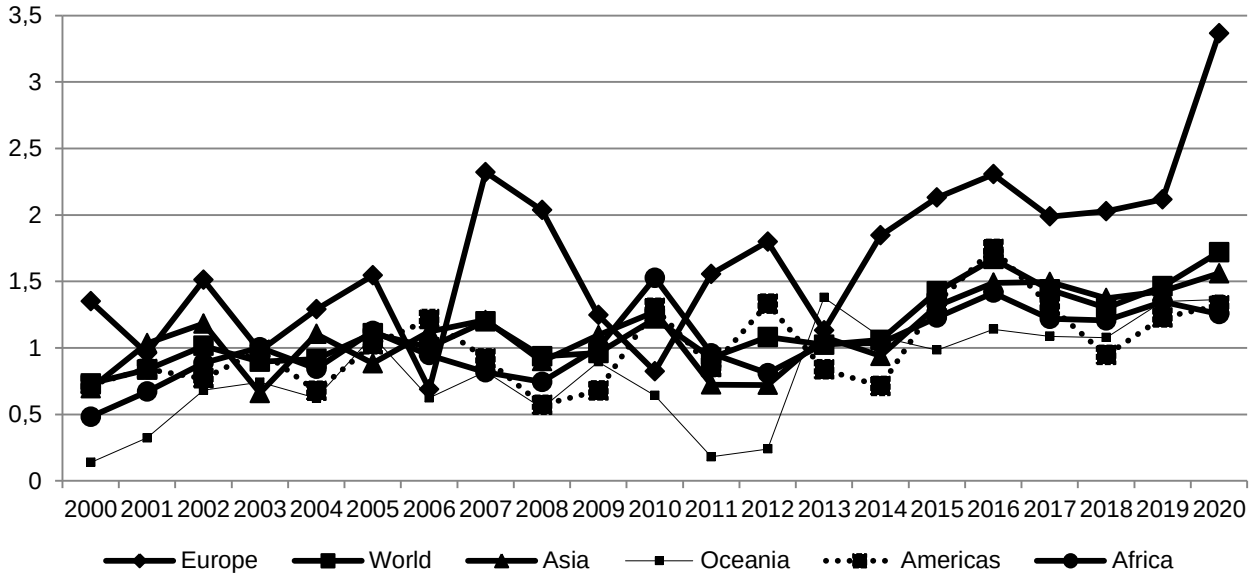

Fig. 1. Temperature change by region

Source: built by the authors on the basis of [6; 7]

Temperature changes in some European cities show an upward trend of temperature increase (Fig. 2).

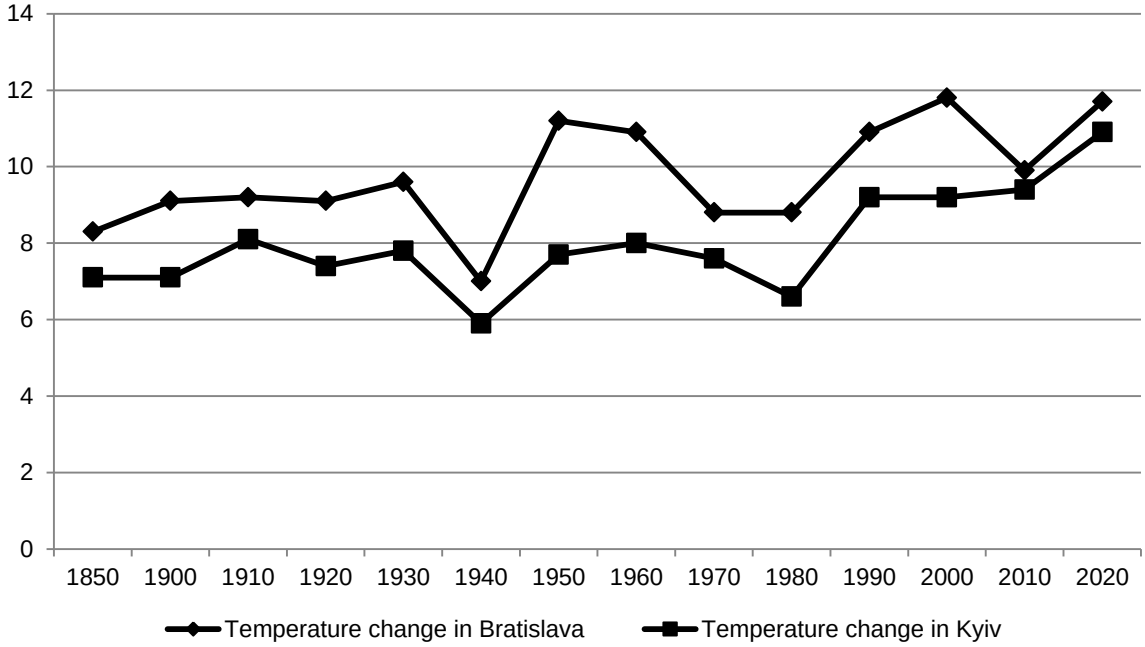

Fig. 2. Temperature changes in some European cities

Source: built by the authors on the basis of [8]

Already in the near future, both positive and negative consequences for agriculture will be observed in various agro-climatic zones, in particular, the extension of the growing season will be a rather favourable factor for the Polissia zone, and in the southern regions it will lead to an increase in dry periods. A study of the impact of climate change under different scenarios on the cultivation of major agricultural crops shows the following trends:

– in the next 10–20 years, favourable conditions for the production of winter wheat will be formed due to the shift of sowing dates by 20-40 days and more effective use of autumn vegetation conditions, which may result in an increase in overall productivity by 20-40%;

– for early spring grain crops (barley, wheat, oats), an increase in the temperature background will cause a drop in their productivity due to a reduction in the growing season and earlier ripening;

– as a result of shifting the border of the Steppe zone to the north, into the modern Forest-steppe, the northern border of industrial cultivation of eggplants, sweet peppers and tomatoes will shift, with a

simultaneous increase in the risk of reducing the territories favourable for growing potatoes, cabbage and cucumbers, which will require the use of pre-sowing preparation measures.

Therefore, from the point of view of increasing agricultural productivity, climate change has both positive and negative consequences. The positives include: improvement of conditions and shortening of harvest times; the possibility of effective introduction of late-ripening varieties (hybrids), which require more thermal resources; improvement of overwintering conditions of agricultural crops and perennial grasses; increasing the efficiency of fertilizer application. The negative ones include: deterioration of grain quality due to an increase in the concentration of carbon dioxide in the air; more frequent and stronger droughts during the growing season; acceleration of humus decomposition in soils; deterioration of soil moisture in the southern regions; failure to ensure complete vernalization of grain crops; increase in the number of pests, the spread of pathogens of plant and weed diseases due to favourable conditions for their overwintering; the increase in wind and water erosion of the soil, caused by the increase in the number of droughts and extreme precipitation; an increase in the risk of freezing of winter crops due to the lack of stable snow cover with a significant decrease in temperature.

Manifestations of climate change also affect forestry, changing the optimal indicators of ecological conditions for forest ecosystems. For the Slovak Republic, for example, this can be very important, considering that 41,36 % of the country's territory consists of forest territory. The total area of the Slovak Republic is 4 903 391 ha, forest lands are 2 028 509 ha [9]. The main effects of climate change on forest ecosystems:

– the growth areas of some breeds will be changed due to changes in the boundaries of natural zones, in some cases, individual productive species will completely disappear;

– the regimes, types, intensity and frequency of the impact on the forest of various damaging factors - insects, diseases, fires, etc. will change;

– there will be changes in the balance of nutrients;

– there will be (mostly negative) changes in the stability and vitality of forest ecosystems, the productivity of woody and non-woody forest plants;

– the effectiveness of the ecological functioning of forest ecosystems will change, in particular, their impact on biogeochemical cycles, biodiversity, and the reduction of carbon deposition volumes. In the implementation of rapid growth scenarios, forests will turn from carbon accumulators into sources of emissions;

– reproductive cycles of forest species, dynamics of successions will change, ecological and social functions of forests will change;

– decrease in the level of biodiversity, especially species with a narrow climatic range (stenotopic), species at the border of the range and endemic species [6].

The dynamics of changes in the yield of grain crops are shown in the Tab. 1.

Table 1

Yield of grain crops, kg per hectare

Countries	Value by years						Increase
	2017	2018	2019	2020	2021	2022	
Ukraine	1433	2295	1743	1960	2240	2500	57.0
China	4753	5527	5701	5830	5889	5886	23.9
India	2294	2676	2861	3010	2963	2981	29.9
Germany	6453	6718	6458	6965	7318	8050	24.8
France	5854	6988	6819	5925	7340	7637	30.5

Source: built by the authors on the basis of [10]

The initial data for calculating the correlation coefficients between the financial and economic indicators of the agricultural enterprises activity and the trends of climate change are given in Tab. 2 and Tab. 3.

Table 2

Climatic average annual weather monitoring for 2009-2021 in Ukraine

Year	Air temperature, °C			Precipitation (PP), mm
	Average minimum	Average (T)	Average maximum	
1	2	3	4	5
2009	-3.3	9.4	21.7	621
2010	-7.1	9.4	24.4	623
2011	-4.1	9.2	21.7	741

continuation of the table 2

1	2	3	4	5
2012	-6.1	9.1	23.7	454
2013	-5.6	9.4	20.8	800
2014	-4.8	9.4	23.7	547
2015	-3.2	10.5	20.8	451
2016	-5.0	9.5	22.3	654
2017	-3.8	9.8	24.0	590
2018	-3.8	9.5	22.5	596
2019	-4.5	10.6	23.6	605
2020	-3.4	10.9	21.7	539
2021	-4.1	9.2	22.4	521

Source: built by the authors on the basis of [8]

Table 3

Production volume (gross harvest) of agricultural crops, thousand tons

Year	Production volume (gross harvest) of agricultural crops, thousand tons					
	Cereal and leguminous crops (C)	Sugar beet (for processing) (S)	Sunflower (Sf)	Potatoes (P)	Vegetables (V)	Fruits and berries (F)
2009	46028	10068	6364	19666	8341	1618
2010	39271	13749	6772	18705	8122	1747
2011	56747	18740	8671	24248	9833	1896
2012	46216	18439	8387	23250	10017	2009
2013	63051	10789	11051	22259	9873	2295
2014	63859	15734	10134	23693	9638	1999
2015	60126	10331	11181	20839	9214	2153
2016	66088	14011	13627	21750	9415	2007
2017	61917	14882	12236	22208	9286	2048
2018	70057	13968	14165	22504	9440	2571
2019	75143	10205	15254	20269	9688	2119
2020	64933	9150	13110	20838	9653	2024
2021	86010	10854	16392	21356	9935	2235

Source: built by the authors on the basis of [10]

The results of the correlation analysis between financial and economic indicators of agriculture and climate change trends are shown in Fig. 3.

Correlations (Spreadsheet3) Marked correlations are significant at p < ,05000 N=13 (Casewise deletion of missing data)								
	T	PP	C	S	Sf	P	V	F
T	1.00	-0.28	0.95	-0.92	0.88	-0.89	0.94	0.91
PP	-0.28	1.00	-0.85	0.76	-0.83	0.97	-0.93	-0.94
C	0.95	-0.85	1.00	-0.34	0.94	0.19	0.60	0.68
S	-0.92	0.76	-0.34	1.00	-0.36	0.70	0.22	-0.12
Sf	0.88	-0.83	0.94	-0.36	1.00	0.06	0.54	0.72
P	-0.89	0.97	0.19	0.70	0.06	1.00	0.72	0.34
V	0.94	-0.93	0.60	0.22	0.54	0.72	1.00	0.58
F	0.91	-0.94	0.68	-0.12	0.72	0.34	0.58	1.00

Fig. 3. Results of correlation analysis of natural and climatic conditions and agricultural crops production volume

Source: built by the authors

The results of the correlation analysis show a greater dependence of production volumes on temperature than on precipitation volumes. But at the same time, the results show that with a decrease in precipitation, the amount of agricultural production will also decrease. The greatest dependence is observed between the amount of precipitation and the volume of potato production, and such a dependence is direct, which indicates that with an increase in the amount of precipitation, the volume of potato production will also increase. In view of the obtained results, cooperation at all levels of the hierarchy is necessary for adaptation to climate change.

The financial mechanism of interaction of agricultural enterprises is a complex multi-structural system that combines constituent elements that have determined and established connections and dependencies, which are the basis of its existence. Thus, parallel processes of exchanges and stimulation, mutual renewal, transformation with their appropriate coordination take place.

Variants of interaction between the state and agricultural enterprises are shown in Fig. 4.

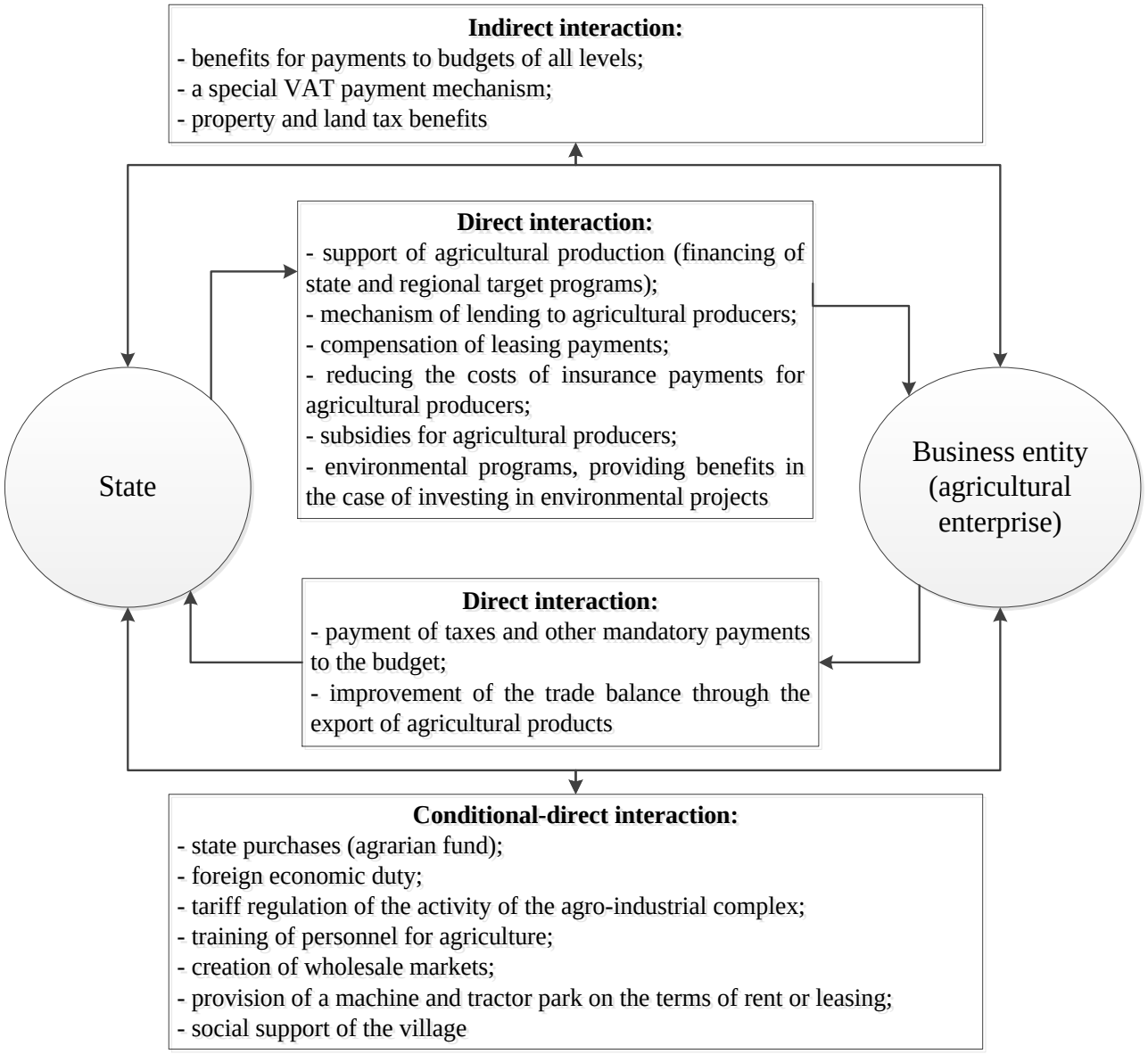

Fig. 4. Variants of interaction between the state and agricultural enterprises
Source: built by the authors on the basis of [11]

Variants of interaction between the state and agricultural enterprises include direct interaction, conditional-direct interaction and indirect interaction.

Taking into account such global challenges as climate change and adverse weather conditions, insurance companies, the state and business entities should work together to develop a quality complex insurance program for agricultural enterprises.

The financial mechanism of interaction of agricultural enterprises with various subjects of interaction during counteraction to global challenges is shown in Fig. 5.

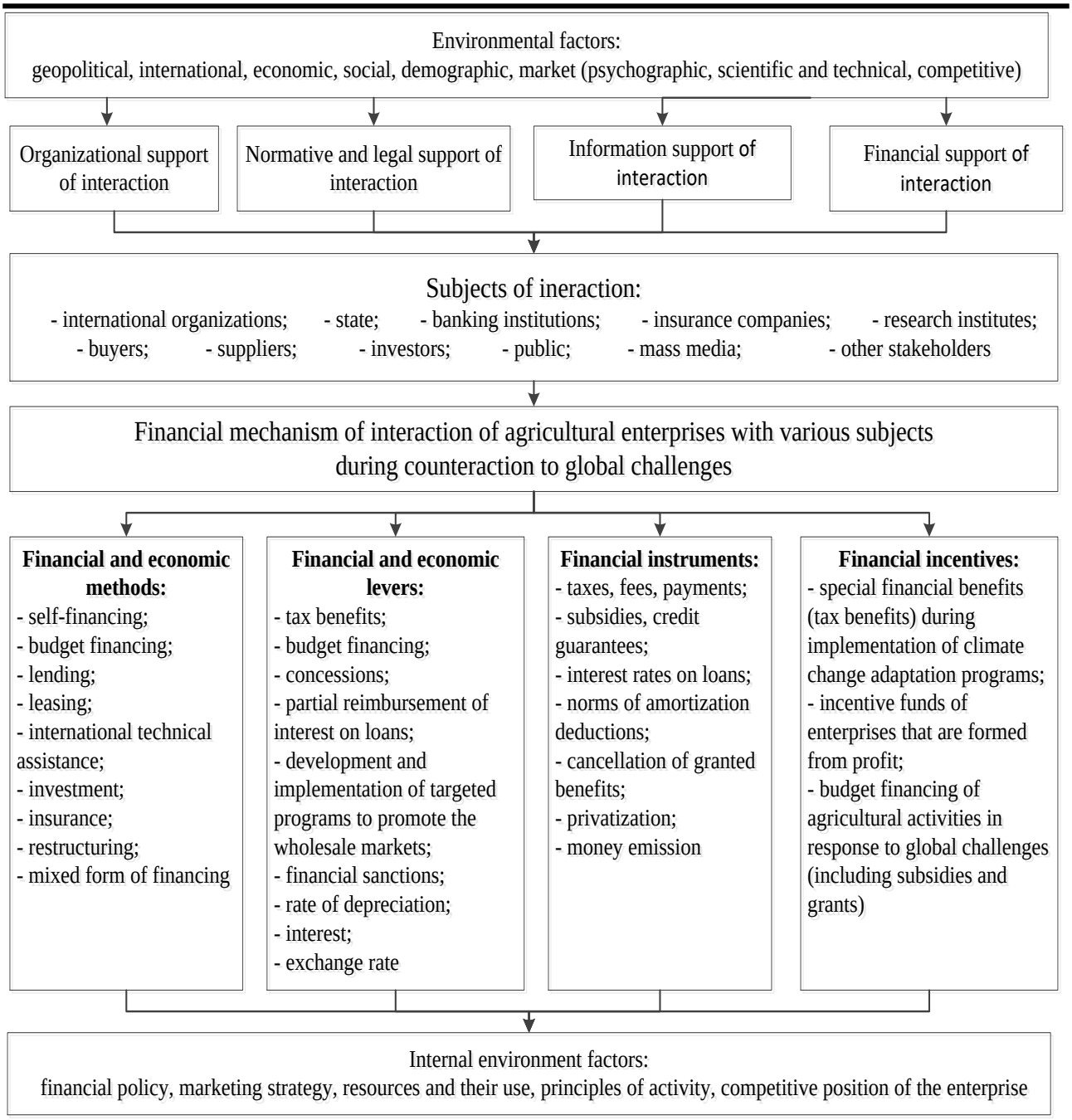

Fig. 5. Financial mechanism of interaction of agricultural enterprises with various subjects during counteraction to global challenges

Source: built by the authors on the basis of [11]

The directions of the transformation of the financial mechanism of interaction and the principles on the basis of which the transformation should be carried out have been determined. The transformation of the financial mechanism of interaction between business entities in the conditions of global challenges consists in changing and improving methods, levers of influence on the results of such cooperation by ensuring close mutually beneficial relations between stakeholders, by forming and using financial resources with the aim ensuring sustainable operation and development of the enterprise in the conditions of global challenges.

Ways of transformation of the financial mechanism of interaction of business entities in the conditions of global challenges are presented in Fig. 6.

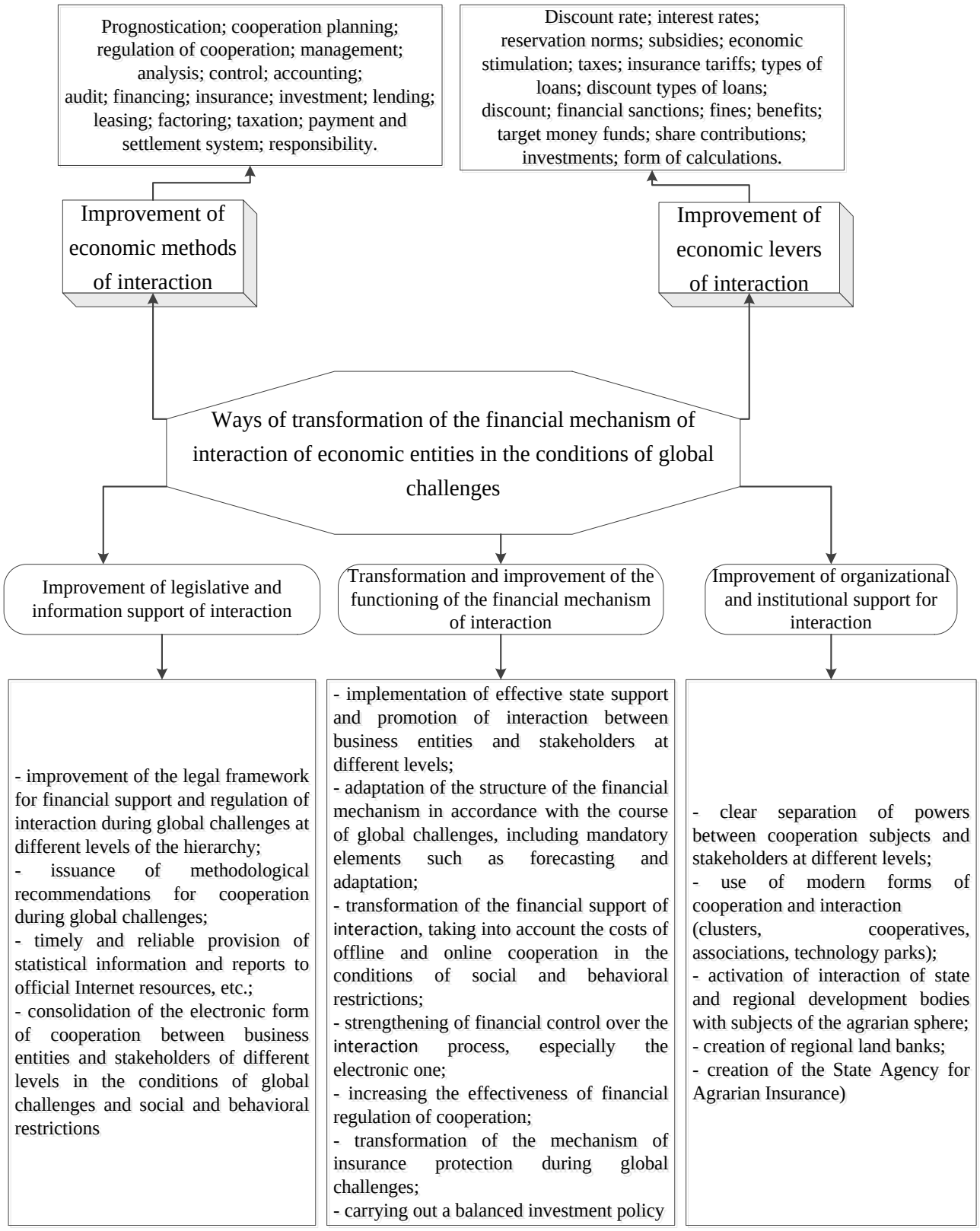

Fig. 6. Ways of transformation of the financial mechanism of interaction of business entities in the conditions of global challenges

Source: built by the authors on the basis of [11]

Measures to improve the effectiveness of the interaction of subjects of different hierarchical levels to counteract global challenges are shown in Fig. 7.

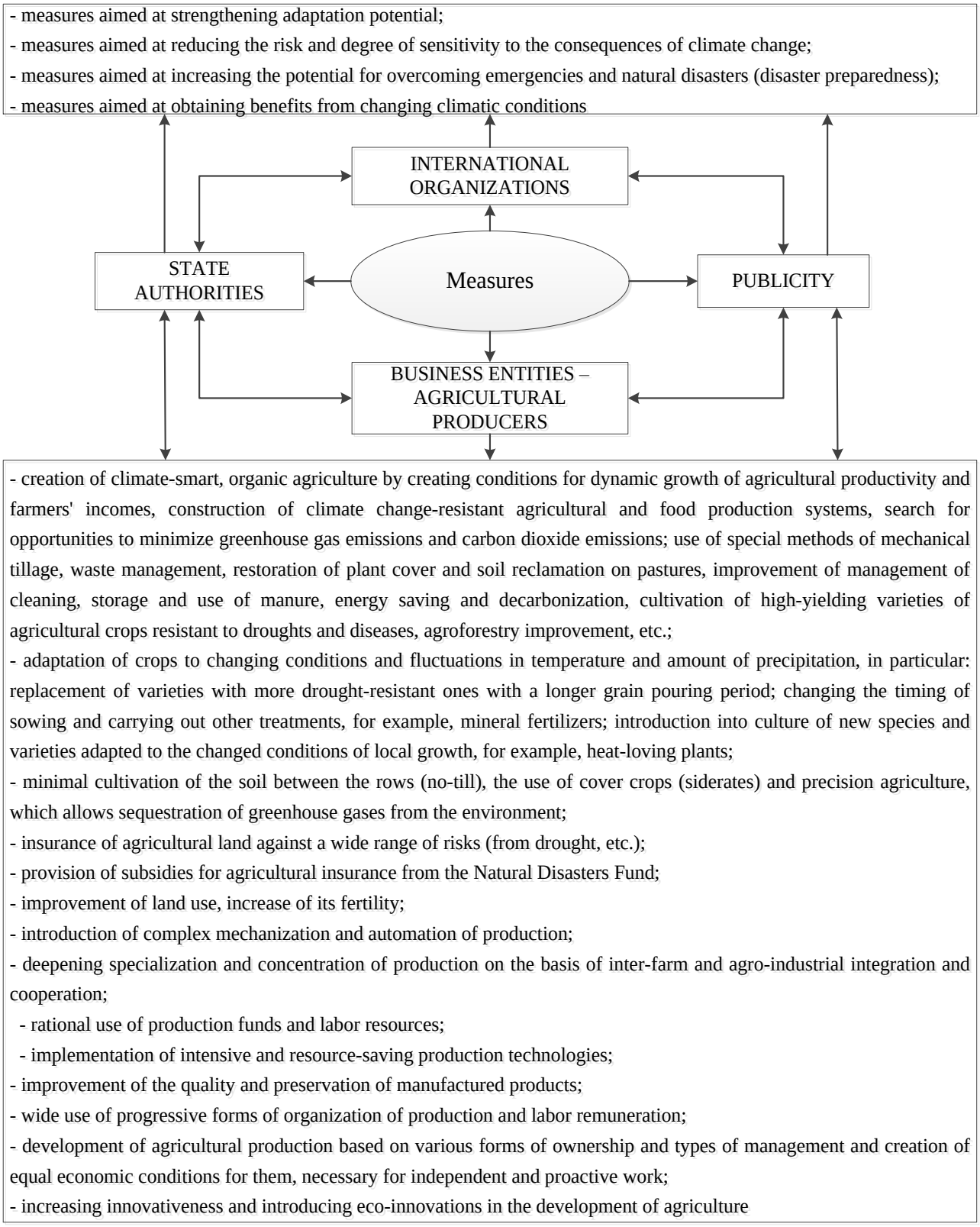

Fig. 7. Measures to increase the effectiveness of the cooperation of subjects to counteract the negative consequences of global challenges

Source: built by the authors

In order to counteract the negative consequences of such a global challenge as climate change, both international organizations and state bodies, the publicity and business entities of various industries, especially those that have a significant impact on climate change and for which climate change can significantly affect the financial and economic results of their activities.

Conclusions from the conducted research. The main directions of transformation of the financial mechanism of business entities interaction in the conditions of global challenges are: improvement of cooperation methods; improvement of economic levers of interaction; improvement of legislative and information support of interaction; improvement of organizational and institutional support for interaction. Adaptation policy is defined as activities and decisions taken by public and private stakeholders at different levels of the hierarchy that purposefully address the effects of climate change and aim to significantly impact stakeholder groups, sectors and geographic areas vulnerable to climate change. Adaptation to climate change should take place according to the following principles:

– interaction at all levels, joint work in partnership, which involves the involvement of the public, ensuring its awareness;

– understanding of existing risks and their limit values, as well as associated uncertainties;

– formation of goals and objectives for adaptation to climate change before implementation of planned measures;

– the application of a balanced approach, which involves the assessment of adaptation measures in the context of the overall effectiveness and socio-economic goals of the state's development, which include solving problems caused by climate change;

– focusing on tasks related to priority climate problems, identifying the main risks and opportunities to reduce them;

– analysis and substantiation of optimal options with the least losses from the point of view of economic efficiency, expediency and multiplication of possible benefits;

– avoiding actions that limit options for future adaptation or reduce the effectiveness of adaptation measures in other sectors;

– regular review of the adaptation strategy and measures in accordance with changing modern conditions.

The listed measures will achieve a combination of economic, social and environmental results, in particular, improving air quality and soil fertility, increasing biodiversity, while nature-based solutions are cheaper and more sustainable than technical solutions.

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