Ukraine Agricultural Policy Adaptation to the Natural Environment Challenges

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Abstract

The study analyzes current challenges in the agriculture of Ukraine caused by global climate changes, irrational use of the main natural resources and their depletion, pollution of the natural environment by emissions into the atmospheric air and discharges into water bodies from the use of agricultural enterprises specializing in pig and poultry products production, lack of sufficient infrastructure and effective waste management system, etc. The problematic issues of inadequate state policy on adaptation to the specified threats were investigated. The world experience in preventing the negative impact of agricultural activities on the environment such as production intensity restrictions, the use of chemicals and pesticides, the amount of hazardous emissions (pollution) and waste, in particular, the CAP policy. The priority areas of state policy in the field of agricultural production adaptation to climate change in the context of European integration are proved; economic tools for the adaptive mechanism of agricultural production based on a balanced combination of coercive-restrictive and incentive-compensatory regulators - taxes and fees - are proposed. The basis of the organizational and economic measures algorithm for the adaptation of agriculture to the threats facing the domestic agricultural sector should be the creation of a regulatory and legal basis for the transition to ecological standards of agricultural activity, public investments in "green growth" and "green innovation" programs. In addition, the algorithm involves application of taxes and fines for land use violations and ecologically safe management practices stimulation to ensure sustainable ecological well-being and preserve the natural environment for future generations.

The expediency of creating a national platform for agriculture adaptation to climate change based on the European one (Climate adapt) on the basis of the National Ecological Center of Ukraine, which will provide information on current and expected climate changes and the vulnerability of various territories has been proven.

The national plan for the agricultural production adaptation is to be implemented at the expense of the formation of adaptation policy mechanisms from the bottom upwards, from territorial communities to the national level, through education and educational activities.

Keywords: state agricultural policy, current challenges in the agriculture, global climate changes, natural resources, European integration, green growth

Адаптація аграрної політики України до проблем природного середовища

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Анотація

Досліджено та проаналізовано сучасні виклики сільському господарству України, зумовлені глобальними змінами клімату, нераціональним використанням основних природних ресурсів та їх виснаженням, забрудненням навколишнього природного середовища викидами в атмосферне повітря та скидами у водні об'єкти від використання сільськогосподарськими підприємствами спеціалізації у виробництві продукції свинарства та птахівництва, відсутність достатньої інфраструктури та ефективної системи управління відходами тощо. Проаналізовано світовий досвід попередження негативного впливу сільськогосподарської діяльності на навколишнє середовище, зокрема обмеження інтенсивності виробництва, використання хімікатів та пестицидів, обсягів шкідливих викидів (забруднення) та відходів, зокрема, політики ССП.

Обгрунтовано пріоритетні напрями державної політики України у сфері адаптації сільськогосподарського виробництва до означених викликів і загроз в контексті євроінтеграції; запропоновано економічні інструменти адаптаційного механізму сформованому на основі збалансованого поєднання примусово-обмежувальних і стимулювально-компенсаційних регуляторів – податків і зборів. Основою алгоритму організаційно-економічних заходів має бути створення нормативно-правової бази для переходу на екологічні стандарти ведення сільськогосподарської діяльності, державних інвестицій у «зелене зростання» та програми «зелених інновацій». Крім того, алгоритм передбачає застосування податків і штрафів за порушення землекористування та стимулювання екологічно безпечних практик господарювання для забезпечення сталого екологічного благополуччя та збереження природного середовища для майбутніх поколінь.

Обгрунтовано доцільність створення на базі Національного екологічного центру України національної платформи адаптації сільського господарства до зміни клімату на основі європейської (Climate adapt), яка надаватиме інформацію про поточні та очікувані зміни клімату та вразливість різних територій.

Реалізація національного плану адаптації сільськогосподарського виробництва має відбуватися за рахунок формування механізмів адаптаційної політики знизу вгору, від територіальних громад до національного рівня, через освіту та просвітницьку діяльність.

діяльність. Ключові слова: державна аграрна політика, сучасні виклики та загрози в сільському господарстві, зміни клімату, природні ресурси, євроінтеграція, податки і збори, зелене зростання

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Introduction.

Being a leading branch of the national economy, agriculture shapes landscapes, economies, communities and culture. It has evolved significantly over the past seven decades, from a predominantly local activity to a global one, since it aims to provide food for the growing world population (Air quality in Europe, 2019). The intensification and expansion of this industry branch around the world has led to large-scale pressures on the environment and climate, threatening not only human health, but also the planet as a whole and the viability of food systems. In addition, agriculture intensification affects social and political stability (Linden, & Brusselaers, 2020). Using an ever-increasing amount of natural resources in the course of the production development and the growth of the economic activity scale leads to a total increase in the anthropogenic load on the environment and a disturbance of the balance in the surrounding natural environment.

Numerous interrelated change factors cause new risks and uncertainties. These factors involve urbanization, digitization, lifestyle changes, climate change, environmental degradation, resource scarcity, and geopolitical instability. Apart from the risks mentioned, they can potentially include crop failures, disruptions affecting international supply chains, price shocks (e.g. fuel and fertilizer) and animal disease outbreaks (e.g. bird flu, African swine fever). However, some of these risks and uncertainties also open up new opportunities for the reconfiguration of agrarian policy and organization of agriculture and food systems both in the world and in Ukraine in particular.

food Although global chains. market competition, industrial processes and productivity growth have turned agriculture into a profitable sector of the economy, the industry exerts significant pressure on the environment, causing environmental problems. The COVID-19 pandemic, Russia's war against Ukraine and, in general, recent global geopolitical events and socio-economic trends have drawn attention to agriculture and food systems. The new challenges make it even more urgent to reconsider the agrarian policy, the peculiarities of farming, and the development of food systems in order to make them stable and sustainable.

Materials and Methods.

A complex of methods was used in the research: abstract-logical (theoretical generalizations and drawing conclusions); retrospective, analytical and comparative analysis (summarization of foreign and domestic experience regarding agrarian policy and legal provision of land use control in accordance with the concept of "Climate smart agricultural" and "Good Agricultural Practices"); statistical analysis (study of the state and dynamics of the resource balance of agricultural production); monographic (studying foreign experience in state support of the agricultural sector and ensuring its innovative development) etc.

The information base of the research was legislative and regulatory acts on economic, social, ecological development of agriculture and its territories, statistical data of the State Statistics Service of Ukraine, the Ministry of Agrarian Policy and Food of Ukraine, the Food and Agricultural Organization of the United Nations (FAO), the Organization for Economic Cooperation and Development (OECD). The materials of informational and analytical publications, including foreign ones, proceedings of scientific and practical conferences, documents of international organizations and institutions, monographs, reference literature, the authors' own research and developments were used.

Analysis of recent research.

The issues of effective agrarian policy formation and its impact on economic development have been studied and are currently being researched by a numerous scientists, both domestic and foreign, including Gadzalo Y. M., Luzan Yu. Ya. (2017). The scientists argue that the problem of effective integration into the world food system, creating conditions for the competitive development of the agricultural sector of the economy and solving the problems of the development of rural areas cannot be solved without systematic modernization of agrarian policy carried out through maximal adaptation of domestic legislation to European standards for running agrarian business and rural development. They believe that agrarian policy should aim to solve the socio-economic problems of rural residents, streamline the agrarian system, develop the land reform, to carrying out land protection and soil fertility preservation, to protect the natural environment, reviving animal husbandry, improving tax and budget policy, ensuring effective mechanisms of agricultural market regulation, growth of agro-industrial production based on innovative development, etc. The authors emphasize the need to implement measures to limit monopoly. unfair competition and shadow business relations.

Sabluk P., Luzan Yu. (2019) consider introduction of comprehensive regulation and coordination of agricultural land circulation as a key element of the state agrarian policy modernization. Currently, environmental pollution, especially that of water resources and air, is increasing simultaneously with the depletion of non-renewable raw materials reserves and energy resources. Apart from these, the forests and fertile lands area is decreasing, certain species of plants and animals are disappearing, which has a detrimental effect on the natural resource potential of social production and negative impact on human health.

Having summarized the historical analysis of the EU Common Agrarian Policy, O. M. Borodina (2016) stated that, the dynamic partnership between citizens, farmers and politicians proves that the agrarian policy is to solve problems and meet the expectations of all citizens and the entire society, which will ensure the sustainability of the national economic development. As noted by

G. Rausser, D. Zilberman (2014): agricultural policy in the United States is a complex and evolving web of governmental interventions in output markets, input markets, trade, public-good investments, renewable and exhaustible natural resources, regulation of externalities, education, and the marketing and distribution of food products. For the US federal government, these interventions have resulted in enormous budgetary costs, huge surpluses of farm products, major disputes with other countries, distorted international markets, and special benefits to interest groups that are often highly concentrated. These same programs, however, have contributed to an agricultural sector whose productivity over much of the last century has been spectacular.

In addition, Alan Matthews (2008) has stated that improving the development coherence of EU agricultural policy requires more liberal market access for developing country agri-food exports than they currently enjoy. But it also requires that the EU put in place policies to protect and assist those developing countries which may not be able to take advantage of improved market access or which may lose out where lower trade barriers lead to preference erosion. Apart from abovementioned, as H. A. Elizabeth and N. K. Mattison (2005). state have pointed out, policy reform is an important driver of changes in agricultural land-use, but there is considerable spatial variation in response to policy and its potential impact on biodiversity. They review the links between policy, land-use and biodiversity and advocate a more integrated approach.

Earl Heady (1962) studied the issue of agriculture contribution to national economic growth and consumer welfare and how it can increase without being penalized in income for doing so? Therefore, the generalization of the scientific achievements of leading domestic and foreign scientists gives reason to claim that the agri-food sector is the driving force of the economy and society. Hence, agricultural policy should be formed on the basis of effective tools and taking into account the goals of sustainable development. And the current war and a number of other challenges confirm the need for urgent adaptive actions regarding the formation of a respectable agrarian policy.

Results.

Over the last decade, the development of agroindustrial production in Ukraine has been taking place in conditions of limited opportunities of the biosphere for self-regulation and growing needs of society. Despite the recent increase in global GDP, which ensured an increase in the standard of living of hundreds of millions of people, the quality of 60% of the world's key ecosystem goods and services necessary for their existence was declining, or these goods and services were used in a consumerist way (Sokolska, 2012). The economic growth was achieved mainly due to the depletion of natural resources - the stocks could not recover, leading ecosystems has been overconsumed and even destructed. The vast majority of economic development and growth strategies were aimed at the rapid accumulation of capital, obtained due to the excessive depletion of natural capital natural resources and the ecosystem, which, in its turn, creates huge risks and problems for future generations.

According to the FAO, 7-10 calories of exhaustible energy are spent to ensure production of just one calorie of food. Moreover, to date, the energy consumption required to obtain a ton of wheat has increased by 100 times. In Ukraine, nearly a ton of natural resources is consumed per a GDP unit, while in the USA they use up only 3 kg. The total energy consumption per unit of GDP in Ukraine is 2-3.6 times higher than in neighboring countries such as Poland, the Czech Republic and Romania (Usenko, Shapovalenko, & Orzhel, 2019).

A huge amount of pollutants enter the atmosphere with emissions produced due to machinery and mobile sources use. According to the Ministry of Environmental Protection and Natural Resources of Ukraine, the share of agriculture in greenhouse gas emissions is 92 million tons, that is, it is the same as emissions from the entire energy sector, including the production of heat, electricity and transport. According to V. O. Melnyk, O. V. Ryabinina and T. V. Kyz (2014), emissions from the use of fields and pastures have increased over the past 30 years and have already exceeded the rate of CO2 absorption by Ukrainian forests. 37% of the total volume of methane emissions comes from animal husbandry, as it is produced mainly by the digestive system of ruminants. This gas makes up 20% of greenhouse gases and its potential to influence the climate is 23 times higher than that of CO2. It can accumulate in the atmosphere for about 12 years (Broucek, 2014).

The largest volumes of emissions are carried out by agricultural enterprises specialized in pig and poultry products manufacturing. Taking into account the number of farm animals across the regions of Ukraine and emission standards per a conventional livestock unit, Vinnytsia, Khmelnytskyi, Kyiv and Dnipropetrovsk regions represent the main zones of increased ecological danger since powerful livestock farming complexes are concentrated in these regions and pollute the environment. For example, the presence of fermentation products at the area of the production facilities of the "Ukrainian Dairy Company" Ltd. can be odored at a distance of 4-5 km away from the enterprise.

Despite the increase in the livestock production profitability, the wastes from enterprises pose a sanitary threat to the surrounding settlements and farms as well as wild animals though the degree of the threat depends on the livestock concentration. For example, large complexes with a livestock exceeding 20,000 conventional animals can be equated to a city with a population of more than 300,000 people in terms of the amount of waste generated. The amount of waste from one dairy cow is equal to 16 human equivalents, from young cattle - up to 12, from a pig - up to 21.

1 kg of beef production gives 25 kg of waste, 1 kg of milk - 13 kg of wastewater. In 2021, animal husbandry and manure distribution caused emissions of 12,655.191 tons of ammonia, which makes 71% of ammonia emissions throughout Ukraine.

Poultry farms and enterprises are particularly severe polluters since they emit microorganisms, dust, and ammonia into the atmosphere and the surrounding areas. The amount of ventilation emissions from one typical poultry house ranges from 200 to 500 thousand m3/h of polluted air, each m3 which contains 3-20 mg of ammonia, 1-3 mg of hydrogen sulfide, 0.10-0.30% of carbon dioxide, 3- 5 mg of dust, 70-900 thousand microbial units (Melnyk, Riabinina, & Kyz, 2013).

Disposal of such a large amount of waste requires huge costs. The cost of sewage disposal facilities for waste storage and processing makes one third of the total cost of the livestock complex.

The most common methods of poultry wastes processing comprise composting and their processing into feed, the use of bioenergy methods and new utilization technologies, etc. Composting is the cheapest method of waste processing, and therefore it is used at enterprises where the financial situation does not allow implementing advanced technologies. Wastes processing composting produces organic fertilizer with a sufficient content of nitrogen, phosphorus, potassium and numerous organic substances. A significant disadvantage of this type of waste recycling process is that the recycled products can only be transported over short distances due to the high transportation cost.

Organic waste processing into cattle fodder additives is worth attention, since about 40% of the nutrients in the feed are not digested by the poultry and the final product contains up to 20-30% crude protein (Viatkin, & Khomiakov, 2008).

Recently, the construction of biogas plants has become economically feasible. They process organic waste from farms and generate thermal and electrical energy, and make organic fertilizer from the fermentation residues. Reduction of the smell and the risk of manure seeping into the soil, underground and surface water decreases the greenhouse gas emissions and, therefore, is a partial solution to environmental problems. Moreover, it also provides additional jobs for local communities.

In addition to the mentioned above, land undergo significant environmental resources load characterized due to extremely high level of cultivation (almost 70%-41.4 million hectares). Such a high level of economic development determines the intensive impact of anthropo- and technogenesis on the surrounding natural environment, including land resources. The excessive expansion of arable land occurs at the expense of sloping land, which leads to a violation of the ecologically balanced ratio of land areas: arable land, natural forage land, forests and water bodies, which negatively affects the stability of agricultural landscapes and causes significant man-made damage to the ecosphere.

As a result of such a "consumerist" approach, land resources are degraded, polluted and depleted at an accelerated rate, though we can't produce enough food is even for the current generation, and the needs of future generations are endangered. Particularly threatening is the progressive degradation and decline in soil fertility which is the basis of the biosphere and agricultural production. Annual losses from the basic types of soil degradation amount to about UAH 40-50 billion, including UAH 23-28 billion of those that occur due to unbalanced losses of humus and nutrients, UAH 17-22 billion due to lack of production and soil loss caused by erosion (Concept of the national, 2022). Part of the land resources is in a pre-crisis state in terms of the level of acidity, salinity, over-compaction, pollution; in some areas the situation is critical with a tendency to deteriorate.

Thus, all indicators characterizing the favorable ecological state of the territory are significantly lower than optimal.

The share of natural territories in the total area is only 25% whereas the maximum permissible figure is 35-40% with the optimal values of 60%, which is not adequate to maintain the ecological balance (Popova, 2012).

Consequently, the natural fodder base for animal husbandry, territories for the biodiversity and seminatural reserves spread are limited, which evidences anthropogenic overloading of agro-landscapes in Ukraine. To assess the degree of ecological stability of the territorial structure and the land resistance to anthropogenic load, we calculated two integral indicators: the coefficient of ecological stability of the territory Ces and the coefficient of anthropogenic load Cal.

The value of the coefficient of ecological stability Ces= 0.39 reveal that the domestic lands ecological state can be considered as stably unstable, the level of anthropogenic load (Cal= 3.49) is increased.

Intensive irrigation and reclamation activities also cause serious problems, such as water scarcity and the reduction of wetlands, perform an important regulatory function in hydrological systems.

Therefore, as a consequence of its production activity, agriculture both spoils the environment and becomes dependent on the destroyed nature. In particular, acid rain caused by SO2 and NO emissions, increased ultraviolet radiation, air pollution, and climate changes cause significant damage to agricultural producers.

According to the European Environmental Protection Agency, more than 20% of agricultural land in Ukraine is contaminated with pesticides and decay products, and about 4% is contaminated with hexachlorocyclohexane (European Environment Agency, 2024).

Moreover, there is a tendency to increase the use of pesticides and plant protection products under intensive crop cultivation technologies, which results in the agrobiocenoses imbalance, increased resistance of harmful organisms and increased risk of environmental and crop pollution. In 2018-2019, according to the State Statistics Service of Ukraine, the average figure indicating the use of pesticides in the active substance increased to 1.3-1.4 kg per 1 ha. In 2017, 24,000 tons of pesticides were used in Ukraine based on the calculation of the active substance, in 2018 - 25,000 tons, in 2019- 24,000 tons and in 2020 - 23,000 tons. It is worth noting that the pesticide load is especially evident in intensive technologies implementation. Actually, in the course of winter wheat cultivation the pesticide load can sometimes increase to 6-10 kg/ha, corn and beets - up to 12-16 kg/ha, vegetable crops - up to 45-50 kg/ha, fruit crops - up to 165 kg/ha.

According to the State Food Service of Ukraine, in 2020, Ukrainian farmers applied crop protection chemicals on 46.2 million hectares, and biomethods were used only 1.7 million hectares. A total of 40.7 thousand tons of pesticides were used in 2020.

Long-term irrational exploitation of land resources, incomplete formation of ecologically safe land use, in particular intensive cultivation with a high percentage of row crops, have led to the development of progressive processes of water and wind erosion of soils. About one third of the country's arable lands come within this categoty. In Ukraine, almost 16 million hectares of land have been eroded, and erosion continues to spread to every fifth hectare of those that have not yet undergone it. Losses of humus on these lands have already reached 30-70% (Hrochov, 2023). Eroded lands in Luhansk, Donetsk, Kirovohrad and Chernivtsi regions reach 50-65% of cultivated land.

The harmful practice of crops growing on steep slopes and overgrazing accelerates the erosion processes. Sedimentation in rivers, lakes and reservoirs, is the side effect of this practice. The most negative impact of these phenomena is observed in Dnipropetrovsk, Donetsk, Kirovohrad, Luhansk, Odesa and Kharkiv regions.

Numerous researches have established that the area of degraded soils is growing, drying and desertification of territories, soils apobiosis is taking place on large territories. Short-term lease contracts do not contribute to land users' interest in sustainable use of land resources. Hence, we can observe an expansion of areas under commercial crops, and anti-erosion protection activities such as optimal crop rotation, transverse soil cultivation on slopes are hardly used. In addition, protective plantations have been cut and new ones are not planted.

In our opinion, it is required to implement new methods and approaches to managing the state of land resources in order to minimize the risks of farming, especially in unstable climatic zones. These should comprise soil fertility management, optimizing the productivity of cultivated crops with specific proposals - what, how, where and when to grow and according to which technologies.

Selection work should be aimed to breed agricultural crops resistant to changes in weather conditions and diseases based on the data on agricultural crops vulnerability, depending on climatic changes, diseases and pests. Selection for ecological plasticity is of particular importance in solving the problem of crop production adaptation to climate change, which makes it possible to obtain stable and high yields under different growing conditions, and to adapt different types of plants for cultivation in adverse climatic conditions, making them more resistant to various weather phenomena and harmful insects. For example, China, being the world leader in wheat production, has gained its positions due to the achievements in proper varieties breeding. Breeding and improvement of new wheat varieties allows Chinese farmers to gain an average yield increase of 1.5 % per year.

No-till soil cultivation retains moisture in the soil, improves water availability, reduces soil erosion, and increases water retention and, therefore, can become an adaptation trend of domestic agricultural enterprises to global climate changes. In addition,

they could implement alternative farming models borrowed from foreign experience, in particular: mini-agriculture (Biointensive Mini-Farming), biodynamic agriculture (Biodynamic Agriculture), technologies (Effective Microorganism EM Technologies), low-input sustainable agriculture (LISA - Low Input Sustainable Agriculture), which are based on a profound understanding of the processes that occur in nature. All these are aimed at improving the soils structure, reproducing their natural fertility and contributing to the formation of ecologically sustainable agricultural landscapes.

The noteworthy technology of minimal processing (sustainable agriculture) has become widespread: it involves drip irrigation and introduction of large amount of nutrients into the soil. Under this technology, only the upper layers of the soil are processed, and the planted seeds are covered with a layer of crushed plant residues. The technology prevents soil erosion, reduces moisture runoff, increases the efficiency of fertilizers, and also reduces the costs of combustive-lubricating materials and the use of labor resources. Brazil, Argentina, Canada, the USA, and Australia are the leaders this technology implementation - no-till cultivation technology use on arable land ranges from 12.5% (Australia) to 57% (Canada) (Yasnolob, Pysarenko, & Chayka, 2018).

In our opinion, it is also appropriate to apply differentiated fertilizing: fertilizers are applied depending on the soil properties in each specific section of the field. This technology not only increases productivity due to the "equalization" of soil fertility on all cultivated areas, but also promotes the rational use of mineral fertilizers.

An organizational and economic mechanism should be developed for adapting the domestic agricultural sector to the challenges of the natural environment in the conditions of global climate changes and the desertification of a part of the territory of Ukraine predicted by scientists. This mechanism should be based on the correct choice of the farming system and can contribute to levelling the global climate changes consequences agriculture. Under scientifically for based approach, global warming can also contribute to a significant increase in the capabilities of commodity producers due to the shift in the range of exotic crops cultivation. Therefore, state support for the implementation of alternative farming systems as a strategy for adapting Ukrainian agriculture to global climate change is extremely important.

Since June 2022, Ukraine has officially became a member of the "LIFE" European action program on the environment and climate (Programme for the Environment, 2023). Within the framework of the project, the country can receive resources

and funding to eliminate the environment damage caused by russian aggression. It should be noted that the "LIFE" Program is a financing tool for environmental and climate measures implemented by the European Union. The Program aims to promote the implementation, renewal and development of the EU environmental and climate policy and legislation through co-financing projects on biodiversity preservation, circular economy implementation, adaptation to climate change, renewable energy development, etc. This Program is designed for 2021-2027 with a total budget of 5.4 billion euros. However, these steps are not enough to keep up the challenges - we need to implement the experience of the EU regarding the formation and implementation of agrarian policy taking into account the changes in the natural environment.

Conclusions.

Investments in ecological resources are tools for adapting agriculture to the challenges of the natural environment. The scientific research vector is aimed at the following key directions: soil fertility management, efficient use of water, production diversification; selection of adapted plant varieties and animal breeds; ensuring sustainable animal welfare and plant protection; mechanization and environmentally friendly modernization of production and implementation of resource-saving processes.

The implementation of the abovementioned measures is possible under the condition of forming an effective agricultural policy, implying, on the one hand, the use of effective economic levers to stimulate producers to comply with ecologically safe business practices, reduce the amount of harmful emissions and production waste, and, on the other hand, the application of fines for violating the environmental safety rules. For this purpose, it is economically expedient to create an electronic database of agricultural producers to carry out effective control of land conservation measures, crop rotation and prevention of corruption in district administrations.

Crop maps are to be compiled indicating when a farmer grows this or that crop. Violation of crop rotation conditions entails financial responsibility (or a ban on this type of activity for several years). Under the conditions of their observance, bona fide producers should be provided with tax preferences. This system should function a way that any agricultural producer would prefer reorienting their activities to an environmentally safe one, rather than paying fines.

Considering decreased the impact of climate change on agriculture and its sustainable development, the post-war reconstruction of Ukraine in this area should include the following measures: - to choose types of agricultural plants with increased resistance to heat shock and droughts, to change the schedules of agricultural crops growing in accordance with new climatic conditions;

- to change irrigation methods, in particular the amount, terms and technologies used;

- to implement effective technologies for water conservation, soil moisture conservation and reduction of siltation and salinization;

- to introduce the latest technologies for wastewater cleaning and reusing;

- to improve water resources management in order to prevent waterlogging, erosion and soil erosion;

- to diversify farms, small and medium-sized agricultural enterprises so as to simplify the process of introducing the best available technologies and practices.

In general, we think it is expedient to create a domestic platform for agriculture adaptation to climate change on the basis of the National Ecological Center of Ukraine on the model of the European one (Climate adapt). It will provide the users with information on current and expected climate changes, as well as on the vulnerability of various territories. Apart from this, it would deal with the development of a strategy for agriculture adaptation to the challenges of the natural environment and climate change, as well as the development of tools used in adaptation planning. Adaptation support tools should include guidelines, instructions, practical recommendations, publications and reports, a list of adaptation options recommended to representatives of local authorities, as well as beginners. All these should be used to prevent unpredictable consequences of anthropogenic impact on the environment. Specific examples, projects and adaptation programs that have already been implemented in a certain region should also be considered. Environmentally safe methods of agricultural production, diversification in crop and livestock production, as well as measures to maintain ecologically valuable arable and forest lands, in particular with the help of innovative and traditional farming methods, should also be highlighted.

It is obvious that due to the constant lack of resources, the underdevelopment of the publicprivate partnership for resources mobilization, the national adaptation plan should be implemented at the expense of the adaptation policy mechanisms formation from the bottom upward, from territorial communities to the national level, that is, through education and educational activities.

We believe that currently, with the powers to dispose local budgets funds, the bodies of executive power and local self-government at the regional level are obliged to develop a regional adaptation program regarding the impact of actual and expected climate changes on crop and animal husbandry indicators, taking into account economic, ecological, and social aspects.

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