INNOVATIVE TECHNOLOGY IN AGRICULTURE AS A COMPONENT OF ENVIRONMENTAL MANAGEMENT

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Innovative technologies in contemporary agriculture appear as an efficient instrument of introduction of ecological management to agricultural companies. The aim of the research is to investigate ecological consequences of agro-innovations. The research is based on methods of analysis, synthesis and logical generalization. The analysis of the publications of national scientists studying the issue of innovation in the agricultural sector has been studied. Terminological identification of the concept of “agroinnovation” has been made. Best innovative technology for each type of agricultural activities has been singled out and grouped. Possible ecological and economic consequences of introduction the innovative technologies in national agricultural production have been predicted.

Key words: agro innovations, innovative technologies, environmental threats, environmental management, agriculture.

JEL Codes: Q55, Q10, Q57.

1. Introduction

In modern conditions the guarantee of conducting the effective agribusiness and simultaneous rational nature management is the development and implementation of innovative technologies. In the conditions of popularizing the process of agroinnovations important is the question of studying their impact on the environment. This task relies on environmental management, which aims to study and to investigate agro innovative technologies, to analyze the international experience in this sphere and to offer the best options to the specifics national agriculture. According to this, there is a need to use the achievements of scientific and technological progress and search for alternative energy sources, which can provide a balanced eco-economical development of the agricultural sector. An important contribution in the study of modern innovative technologies in the agricultural sector such scientific made as O. Popova (issues of methods of innovative processes management in agro-industrial complex) (Popova, 2007), N. Zinovchuk (alternative energy sources in agriculture) (Zinovchuk, 2007), A. Cote (theoretical aspects of innovation-driven growth of agrarian sector of economy and its organizational-economic grounding) (Cote, 2008), Ju. Bukhvostau (influence of investments on formation of economy of innovative type by the example of agrarian sector) (Bukhvostau, 2009), A. Shubravska (innovative transformations of agrarian sector of economy) (Shubravska, 2012). Separate development of agro innovative technologies were made by V. Garmashov (organic

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production) (Garmashov, 2010), V. Kaplunenko (nanotechnology in agriculture) (Kaplunenko, 2008); O. Tatariko (space technologies in agriculture) (Tatariko, 2007); J. Tatiber (tillage technology Strip-till) (Tatiber, 2012); S. Tribel' (genetically modified organisms) (Tribel', 2012) and others. However, the question of implementation the innovative technologies in agriculture aimed at preserving the environment is poorly studied and requires additional study. The aim of study: to study the existing international experience in implementing agro innovations and to analyze their ecological and economical consequences, to highlight the optimal group of innovative technologies in the sectors of agriculture. The object of study is the practical aspect of implementation of innovative technologies in national agriculture. The practical novelty of this study is the determination the environmental consequences of each type of innovative technologies and as a result prevention the emergence of possible environmental threats. During the research methods such as analysis and synthesis, logical generalization were used.

2. Results of study

National agricultural production is one of the biggest users of natural resources and at the same time has the greatest negative impact on the environment. This problem can be solved through the introduction of environmental management in agricultural enterprises. One of the components of environmental management is agroinnovative technology. Table 1 shows the identification of terminological concept "agroinnovation".

<table>
<thead>
<tr>
<th>Author</th>
<th>Identification of the concept of &quot;agro innovation&quot;</th>
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<tbody>
<tr>
<td>O. Popova (2007)</td>
<td>Agroinnovation – is an innovation that affects directly (or indirectly, within the technological chain) processes, the participants of which are people, machine (equipment, tools, etc.) and a component of the environment (animal, plant, etc.), whose existence in the natural environment (without person) is impossible or possible with loss of basic functional characteristics.</td>
</tr>
<tr>
<td>O. Kot (2008)</td>
<td>Agroinnovation – is systematic implementation of the results in the agricultural sphere of scientific and research work, which leads to positive qualitative and quantitative changes in the characteristics of the relations between the biosphere and technosphere and improves the environment.</td>
</tr>
<tr>
<td>Ju. Buhvostov (2009)</td>
<td>Agroinnovation – is the result of work received thanks to application of new scientific knowledge, which makes the process of functioning and development industrial and economical system IES in the direction of increasing its efficiency, stability and system quality relationships.</td>
</tr>
<tr>
<td>N. Ogienko (2012)</td>
<td>Agroinnovation – is final result of implementation innovations (sort of plants, animal breeds, plant protection and animal production technologies, etc.), which resulted in a profit or effect (economic, social, environmental, etc.).</td>
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Analysis of the definitions given in the Table 1 testifies to the fact that every interpretation of the term "agroinnovation" forsees balancing ecological and
economic processes in agriculture, combined with the use of scientific and technological progress. Today most agricultural innovations are developing in sectors: crops, livestock and received alternative sources of energy for agriculture. In Table 2 agroinnovational technologies are grouped, which have been tested in developed countries and have a positive trend towards improving environmental and economical characteristics of agricultural production.

Table 2. Innovative technologies in agriculture and their environmental impacts

<table>
<thead>
<tr>
<th>Innovative technologies</th>
<th>Eco-threats</th>
<th>Characteristic of eco-influences of innovations</th>
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<tbody>
<tr>
<td>D’rip irrigation</td>
<td>None</td>
<td>Economy of irrigation water, electricity and fertilizers; reduction of soil erosion.</td>
</tr>
<tr>
<td>Selection of agricultural crops</td>
<td>None</td>
<td>Increase of resistance to soil and climatic conditions and pests; obtaining of new varieties of plants.</td>
</tr>
<tr>
<td>Organic farming</td>
<td>None</td>
<td>No negative influence of agricultural production on the environment</td>
</tr>
<tr>
<td>Resource-saving tillage</td>
<td>Deterioration of soil’s features</td>
<td>Reduction of mechanical stress on the soil; reduction of water and air erosion; improvement of the root system of plants; compaction and soil acidification; deterioration of the physical properties and the phytosanitary condition of the soil and crops.</td>
</tr>
<tr>
<td>Genetic engineering and genetically modified organisms</td>
<td>Threat to human health</td>
<td>Negative impact on human health – immunosuppression, allergic reactions, toxicity of GM food; emergence of carcinogenic and mutagenic effects.</td>
</tr>
<tr>
<td>Space Technology in Agriculture</td>
<td>None</td>
<td>Prevention of natural environmental threats.</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>Toxic pollution</td>
<td>Accelerate the photosynthesis of plants and make air ozoned; possibility of toxic effects of nanoparticles.</td>
</tr>
<tr>
<td>Selection and breeding technology</td>
<td>None</td>
<td>Creating new and improving existing breeds, high-performance hybrids.</td>
</tr>
<tr>
<td>New feeding system</td>
<td>None</td>
<td>Reduce the cost of feed and reduce the feed waste.</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>Threat of infection</td>
<td>Improving of animal health and preservation of their the gene pool; receiving transgenic animals as donors of internal organs for transplantation to man; the possibility of transmission of infections.</td>
</tr>
<tr>
<td>Creation the complex of natural macro- and micro-climate for animals</td>
<td>None</td>
<td>Possibility of free movement and free access to feed for animals.</td>
</tr>
<tr>
<td>Alternative Energy Sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving biogas and organic fertilizers from by-products of livestock</td>
<td>None</td>
<td>Reduction of wastes, reduction of emissions of pollution into the environment by using alternative energy, reduction pollution of soil using organic fertilizer.</td>
</tr>
<tr>
<td>Biodiesel and bioethanol from plant cultivation products</td>
<td>Deterioration of soil’s features</td>
<td>Reduction of wastes, reduction of pollutant emissions into the environment by using alternative fuels, depletion of lands by growing the certain types of energy crops.</td>
</tr>
<tr>
<td>Use of straw as an alternative energy source</td>
<td>None</td>
<td>Reduction of wastes, reducing of emissions of polluting into the environment by using alternative energy, reducing pollution of soil using organic fertilizer.</td>
</tr>
</tbody>
</table>
In national agriculture international newest developments are introduced, but innovation processes, it is not only guarantee of improving the efficiency of agricultural production, at the same time they may make factor of various threats, such as the negative impact on public health; neglect of natural resources by enhancing anthropogenic pressure as a result of the intensification of agri-business and uncontrolled use in agriculture not enough checked innovative technologies (Shubravs'ka, 2012). Therefore, farmers should consider the appropriateness of certain features agroinnovations of domestic agricultural production, and above all stick to the principle of technological and environmental safety.

One of the most resource-saving innovations is drip irrigation, its essence is to create conditions for sustainable management of soil, including hydrological, thermal, biological profiles. The use of this technology helps agriculture hardly depend on the conditions of natural moisture supply (Kovalenko, 2007). The difference of drop irrigation from other methods of irrigation, lies in the fact that it allows you to maintain optimal soil moisture of the root level of soil during the vegetation period by avoiding significant fluctuations in this indicator. In Ukraine, the leader in the implementation of agroinnovations is the largest in size among land banks, Ukrainian agricultural holding Ukrlandfarming, it plans to increase till 2015 agricultural crops area under drip irrigation in two times - to 10 thousand hectares. This innovative technology is economically effective and environmentally safe way of irrigation. In the last decade the world's most popular innovation was the selection of agricultural crops, but today it much inferior to the newest marker selection. This agroinnovation has some differences from traditional selection, the fact is that the selection marker allows quickly evaluate out-seeds for the presence of specific genes and control them during selection, increasing the reliability and efficiency of selection, reducing the period of creation new varieties and reducing costs (Shubravs'ka, 2012). This innovative approach is cost-effective and eliminates the environmental risks to the environment.

The next most promising and ecologically safe kind of agroinnovation is organic farming. It foresees organic cycles of agriculture, refusal from the use of mineral fertilizers and pesticides, the use of compost, conservation of edafon and stimulation of biological activity of soils (Garmashov, 2010). Today Ukraine is on the 20th place in the world in the production of organic products, the number of enterprises is growing every year. Thus, in 2007, dynamics of organic production in Ukraine in 2007 amounted 430ths euro, in 2013, according to preliminary calculations of the Federation of Organic Movement in Ukraine, this indicator is 12mln euro. Considering the world tendency of high efficiency of organic production and natural agricultural potential, Ukraine can enter the list of the leaders in this sphere of agroinnovation in a couple of years.

Also ecologically important in modern agriculture is agroinnovation of resource-saving tillage, this resource-safe type of innovation is in the newest system of minimum tillage and precision agriculture: «Mini-till», «No-till», «Strip-till». Agroinnovation «Mini-till» forsees minimizing the technical and technological influences on the soil during its cultivation, that increases economic efficiency and eco-
logical compatibility of the process growing up agricultural crops due to reducing weather and climate influence, a significant reduction of fuel consumption, fertilizer, ways of protection the plants, reducing the use of agricultural machinery, increase productivity, optimization of crop rotation, improving the condition of the environment (Shubravs'ka, 2012). As for innovative system «No-till», it is in the cultivation of soil, which does not offer mechanical solutions to remove seals at a depth of 30-35 sm. However, it is the ideal system of soil tillage for the protection surface from erosions, because after harvest and organic remnants remain on the soil’s surface. And system «Strip-till» provides minimum tillage, just only in that part of soil, where exactly seeding will pass (Tatiber, 2012).

The next kind of agroinnovation, the most controversial among modern scientist’s views, is genetic engineering and genetically modified organisms. It has high economic efficiency, but also has a great threat to human health. The use of genetic engineering is provided by the identification, removal of genes and inclusion them into the genome of existing varieties enables you to provide them with new economically valuable features: by resistance to pests, pathogens, herbicides, by unfavorable soil and climatic conditions, by the ability to synthesize bio-pesticides and hormonal substances for implementation of beneficial insects, to destroy chemical pesticides and other toxic substances found in soil, water, etc. (Tribel', 2012). In many European countries there are ”GMO free regions” and they even completely refuse from especially dangerous varieties of products (monsantivska corn strain of MON 810 and GM potatoes «Amflora»). Therefore, the use of genetic engineering in agriculture should be decided on national level, taking into account all positive and negative indicators of this tendency.

In modern world it is difficult to imagine any branch of economy without the use of new technologies, especially the agricultural sector. Space technologies in agriculture significantly simplify the process of land use. Sales achievements of space industry is the most appropriate condition for the intensification of agricultural production (Tatariko, 2007). In particular, they use the following space systems, as: «Rapid Eye», CORINE Land Cover (Coordination of Information on the Environment), Global Positioning System (GPS). They provide a crop capacity monitor and count the number of resources such as fertilizers or herbicides, which are necessary for the use, considering the specific situation. This reduces productive costs through more efficient use of material and technical resources and reduce negative influence on the environment (Shubravs'ka, 2012).

Also today agroinnovative nanotechnologies are becoming popular – a set of methods and techniques, which ensure the possibility in controlled way to create and modify objects, which include components of size less than 100 nm, and which have a fundamentally new quality and make it possible to integrate them into a fully functioning system of macro-scale (Kaplunenko, 2008). Most often they are used as fertilizers, disinfection, products for the cultivation of harvest and so on. These innovative technologies, if used improperly, or storage can pollute the environment, so the coun-
try should monitor the latest developments and certified in accordance with their specified requirements.

As for the animal husbandry sector, the innovative technologies are used in the areas of selection and breeding technology, they are popular and important factors of development of animal husbandry. This innovation in Ukraine has government support and is regulated by objectives of "State target program of development of Ukrainian villages for the period up to 2015", provided for the establishment of the modern state system in animal breeding. Efficiency of this program directly depends on the rates of updating the main herd and creation of base of tribal resources, which can provide access to foreign markets for animal husbandry. This innovative technology is environmentally safe and has no risk of environmental threats. Highly effective is a new feeding system, they provide a reduction of usage the amount of feed due to the exact dosing and balanced components of feed. Current standards calculate the needs of animals in energy, dry substance, crude and digestible protein, carbohydrates, crude cellulose, crude fat, macronutrients, microelements, carotene, vitamins. The mentioned above agroinnovation is an example of rational use of natural resources and is safe for the agricultural sector. Another type of innovation in livestock is the application of biotechnology, the results of these studies are used to improve animal health, treatment of people, improve the quality of animal products, environmental protection and preservation of the gene pool. Application of biotechnology enables to identify animals, which are genetically resistant to various diseases and it is also directed to use them in the selection process (Burkat, 2008). Application of biotechnology of agroinnovation does not have any threats for the environment, on the contrary it is aimed to improve the economical and environmental indicators of agricultural production.

Another new innovation is the creation of complex with natural macro- and micro- climate for keeping farm animals. This is a qualitatively new approach and it is completely different from the national standards. As a result the economical indicators of animal complex are increasing significantly, due to the enlarged milk yield, more increase of certain weight and so on. This innovative technology is related to the organic livestock and has only positive ecological and economical consequences.

One of the most important questions of modern agriculture is the search of alternative sources of energy, which can be possibly produced from adverse agricultural products. For the last decade the world's leading countries have actively studied and developed this question. Today the leading countries in the use of commercial energy installation are: Denmark, China, Spain, United Kingdom. Only in Denmark today more than 10 thousand farmer straw fired boilers employ (0,1-1,0 MW) and about 55 boilers in the district heating system (0,5-12 MW). Besides, 8 CHP (2-28 MWe) and 4 power stations with straw use wood chips, solid waste or fossil fuels (coal, natural gas). The largest in volume consumption of straw (170 thousand tons / year) is the power station Fyn 35 MWe (Straw ..., 2011; FYN ..., 2012). In Ukraine the agricultural industry has enormous potential for the production of energy re-
sources, but consumes only 17 ths tons (in oil equivalent) of biofuel and waste, which is about 1% of total energy consumption (Strategichni ..., 2012).

The most effective innovative technologies in reception of alternative sources of energy in agriculture, taking into account international experience and the specifics the national agricultural sector are: receiving of biogas and organic fertilizer from by-products from livestock. Alternative recast of secondary animal products gives the following results: 62 cubic meters of biogas and 17.4 kg of fertilizer (NPK) are derived from 1 ton of manure, and from a ton of chicken manure accordingly 60 cbm of gas and 40 kg of fertilizer (NPK). The next is the production of biodiesel and bioethanol from the plant production. The recast of plant products enables to obtain alternative types of energy for agriculture. The most common is the use of such crops as oilseed rape and other oil crops; of 1 ton of rapeseed it is obtained 420 kg – biodiesel; of 1 ton of corn you get 450 kg of ethanol. Important for the agricultural sector is the use of straw as an alternative energy source. In order to use the straw as a source of energy, it is processed into granules or pressed into briquettes and burned in boilers. The straw can be used directly both as organic fertilizer and for getting biogas and, after fermentation, as a biological fertilizer. Besides, the straw is used as fertilizer, taking directly into the soil after the harvest of crops, and as fossil fuel for reception the heat, which can save a significant part of natural gas. A ton of straw, while burning for getting heat, is replaced by 400 cbm of gas and when using it as the bedding to farm animals will provide the receiving of 8 tons of manure (Strategichni ..., 2012).

To realize the potential of getting the alternative sources of energy in agriculture is not enough to study only international experience. It is required the full support both from country and the appearance of investors, who are interested in the developing of this question. Another important factor is the development of the biofuels market in Ukraine. There obstacle of full functioning is the settlement of legal sphere in introduction the strict standards as for the content of biological components in traditional kinds of fuel, as well as emissions into the atmosphere remnants of combustion products.

3. Conclusion

1. For the national agricultural sector the necessary condition for the development of this sphere and for increase of export potential is the active study and implementation of innovative technologies.

2. Important is the use of the newest developments, which exclude the possibility of appearing the environmental threats both for industry and for the environment. The very environmental management will provide a rational approach to application the agroinnovative technology.

3. Consequently agriculture will increase the gross output, significantly reduce energy costs, provide rational and economical use of natural resources, reduce the risks of environmental pollution and in its turn lead national agribusiness to a new level of economic development.
References

Šiuolaikiniame žemės ūkyje inovatyvios technologijos yra efektyvi aplinkos apsaugos valdymo priemonė. Šio straipsnio tikslas – įvertinti žemės ūkio inovacijų ekologinius padarinius. Straipsnyje, taikant analizės, sintezės ir apibendrinimo metodus, apžvelgti moksliniai darbai, nagrinėjantys inovacijų žemės ūkio klausimą, atskleista sąvokos “agroinovaijos” prasmė, išskirtos ir suskirstytos atskiroms žemės ūkio veikloms geriausiai tinkančios inovatyvios technologijos, įvertinti minėtų technologijų taikymo ekologiniai ir ekonominiai padariniai.

Reikšminiai žodžiai: agroinovacijos, inovatyvios technologijos, grėsmės aplinkai, aplinkos apsaugos valdymas, žemės ūkis.

JEL kodai: Q550, Q100, Q570.