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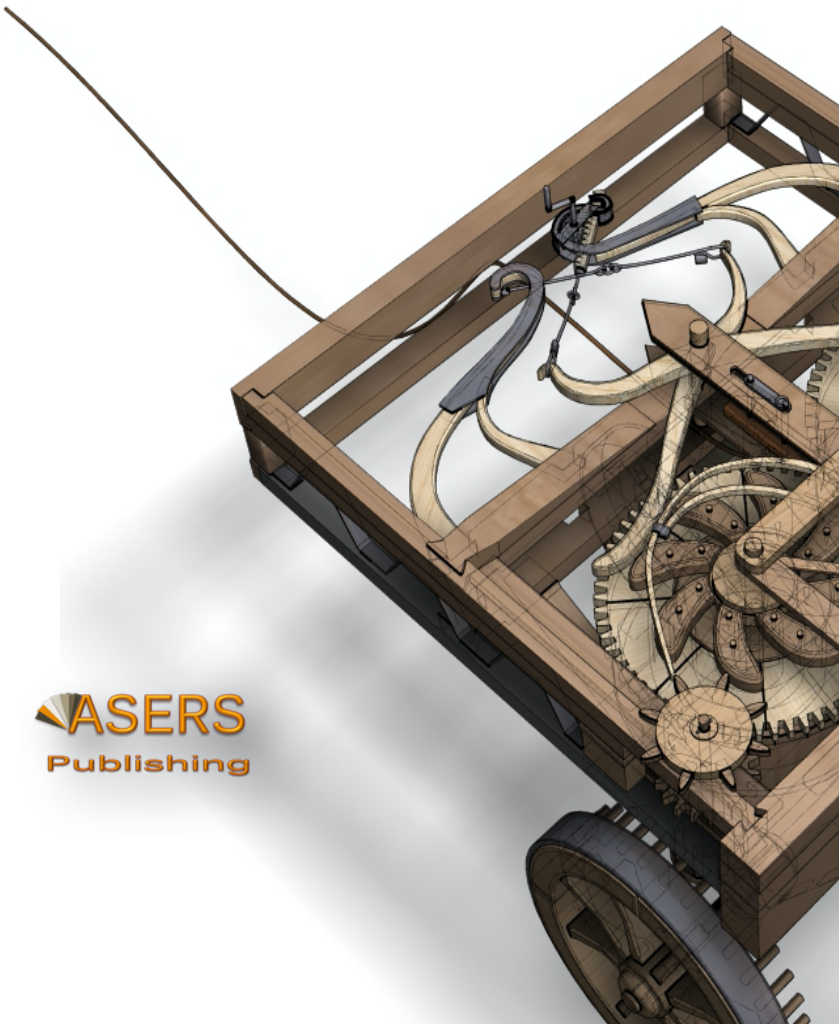

Quarterly
Volume XIV
Issue 3(67)
Summer 2023
ISSN 2068 – 7729
Journal DOI
https://doi.org/10.14505/jemt

ASERS Publishing

Summer 2023
Volume XIV
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http://www.asers.eu/asers-publishing
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Table of Contents:

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Volume XIV
Issue 3(67)

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Journal DOI: https://doi.org/10.14505/jemt

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DOI: https://doi.org/10.14505/jemt.v14.3(67).02

Waste Management Strategy of Agricultural Enterprises to Improve the Efficiency of Rural Development

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Suggested Citation:

Makhmetova, D. *et al.* (2023). Waste Management Strategy of Agricultural Enterprises to Improve the Efficiency of Rural Development. *Journal of Environmental Management and Tourism*, (Volume XIV, Summer), 3(67): 623-631. DOI:10.14505/jemt.v14.3(67).02

Article's History:

Received 7th of March 2023; Received in revised form 23rd of March 2023. Accepted 27th of April 2023; Published 2nd of June 2023.

Abstract:

In the context of modern trends in the greening of the economy, sustainable development, changes in the structure of agricultural production, and the situation that has developed in Kazakhstan with the accumulation, utilization, and disposal of waste, the issues of agricultural waste management remain relevant and require further scientific research and sound practical solutions. The purpose of the article is to form strategic directions for waste management of agricultural enterprises, where the main place is occupied by effective waste management in the context of crop production, animal husbandry, animal tissue, and agrochemical waste. The article presents the principles of a Waste Management Strategy of agricultural enterprises, and a tree of objectives of the Strategy of agricultural enterprises is formed. The features of effective management of agricultural waste, including plant and animal waste, and directions for effective management of agrochemical waste are determined. Reduction of soil and groundwater pollution in the implementation of effective waste management of agricultural enterprises, as well as measures to minimize the formation of agricultural waste, are summarized. The main measures in state incentives for the effective management of agricultural waste are identified.

Keywords: agricultural enterprise; waste; waste management; waste management strategy; environment.

JEL Classification: Q53; O13; Q15.

Introduction

Agricultural production, which has been carried out for decades without considering the negative consequences for the environment, causes the emergence of many environmental problems, in particular, environmental pollution with waste (Zhang *et al.* 2012, 1386). The volume of agricultural waste (waste generated during

agricultural production (Salkhozhayeva *et al.* 2022, 131)) in the world did not exceed 3% of the total amount of waste generated in recent years (Asim *et al.* 2015, 26). However, agricultural waste is a huge problem if it is not disposed of properly (Khoruzhy *et al.* 2022) since it can hurt the environment. It is a source of air (Kulshikova *et al.* 2023, 65), water (Martirosyan *et al.* 2022, and land (Kuldybayev *et al.* 2021, 312) pollution, which leads to economic losses and social problems (deterioration of the health and quality of life of the population) (Ibatullin *et al.* 2014, 38). In addition to the dangers of landfill accumulation and incineration, chemicals that are used in agriculture can cause pollution if they end up in the wrong places. For example, pesticides can cause massive levels of pollution in rivers and streams (Ivanova *et al.* 2022, 119). Polluted water damages the ecosystem and drinking water and can lead to the death of animals (Sammoudi *et al.* 2023, 184).

Of the total amount of waste generated annually in agriculture, less than half is recycled (used as secondary material or energy resource) (Isrun *et al.* 2021, 583). The rest is incinerated or taken to landfills, where it continues to pollute the environment. However, agricultural waste can be effectively used as a fertilizer (Kuldybayev *et al.* 2021, 312), an energy source (Lansing *et al.* 2006, 5881), or a secondary raw material (Bayazitova *et al.* 2023, 202). That is why solving the problem of agricultural waste management is relevant.

1. Literature Review

Considering the greening of the economy and increasing environmental standards in most developed and developing countries, including Kazakhstan, many scholars consider the issues of effective waste management. Thus, numerous works concern the development of waste-free production of agricultural enterprises (Jędrczak 2018, 72; Kuznetsova and Zinich 2021b, 120; Shamtsyan *et al.* 2011, 17). Studies are devoted to the analysis of agricultural waste management and prospects for its further use (Ghisellini *et al.* 2014, 11; Kuznetsova and Zinich 2021a, 210; Shevchenko *et al.* 2013, 17). The economic and environmental advantages of using the potential of waste as a valuable secondary resource are investigated in (Bruun *et al.* 2006, 251; Foo and Hameed 2009, 39; Sidorenko and Kutrovskii 2016).

The research examines the role of waste in ensuring state economic and environmental security (Kamenik 2013, 62; Omodero 2021, 1379), strategic management of innovative development of interrelated waste processing industries (Mamin *et al.* 2013), and strategic directions of waste processing by agricultural enterprises (Yesil *et al.* 2014, 2132).

Thus, it is necessary to conduct logical research and form a Waste Management Strategy (hereinafter referred to as the Strategy) for agricultural enterprises, which will accumulate previous experience and contain relevant proposals for improving waste management for the long term (Khoruzhy *et al.* 2023).

The purpose of the study is to form strategic directions for waste management of agricultural enterprises, where the main place is occupied by effective waste management in the context of crop production, animal husbandry, animal tissue, and agrochemical waste.

2. Methods

The climate, geography, and the availability of sufficient land, water, and labor resources in Kazakhstan contribute to the development of agricultural production in the country, which is important for the state's economy. The country is actively preparing specialists trained both in companies from Kazakhstan and abroad. Expert experience is actively accumulating, justifying the use of the Delphi method.

The study took place in 2022 at the L.N. Gumilyov Eurasian National University (Kazakhstan).

The main research method was the Delphi method (Bezpalov *et al.* 2023), which includes three stages: preparatory, main, and final.

At the preparatory stage of the study, a group of 20 independent experts was selected, for whom the research problem was formulated: "Development of a Waste Management Strategy for agricultural enterprises to improve the efficiency of rural development". The analytical group was made up of the authors of this study.

At the main stage, this problem was divided by the experts into several separate questions, from which the analysts selected the main ones, including the need to define the goals and principles of the Strategy. Based on this a questionnaire was compiled, in which the task was set to specify the main goals and principles of the Strategy.

Based on the experts' answers to the questionnaire, the principles of the Strategy were determined, the tree of the Strategy's goals was compiled, and the strategic and operational goals of waste management of agricultural enterprises were determined. Thus, the majority of the experts, when familiarizing themselves with alternative expert opinions, indicated the need to finalize the questionnaire regarding the specification of priority policy measures concerning each of the operational goals indicated by the experts.

The result of the application of the Delphi method was an agreed expert position on the strategic and operational objectives of waste management of agricultural enterprises, as well as priority policy measures concerning each of the operational objectives.

3. Results

The research conducted allowed forming of the Strategy.

The goal of the Strategy was to provide a basis for creating an efficient, cost-effective, and environmentally friendly waste management system for agricultural enterprises, which will help improve the environment and obtain valuable secondary products, as well as energy carriers for the energy autonomy of enterprises. The principles of the Strategy were defined:

- the principle of the hierarchy of waste management of agricultural enterprises, which provides for actions concerning waste management in the following sequence: preparation for reuse; waste recycling; use of recycled waste;
- the principle of prevention, which provides that if there is evidence of environmental risk, appropriate precautions should be taken;
- the principle of minimizing the impact of the implementation of the Strategy on the environment, which provides that enterprises will use recycled waste in the most environmentally friendly way;
- the principle of transition to a closed-loop economy, which assumes that the volume of products, materials, and resources is used in the economy for as long as possible and waste generation is minimized.

The Strategy of agricultural enterprises should be based on interrelated goals, the achievement of which will achieve the main goal of the Strategy. The tree of Strategy objectives is shown in Figure 1, and the ratio of strategic and operational objectives of waste management of agricultural enterprises is shown in Table 1.

Figure 1. The tree of objectives of the Strategy of agricultural enterprises

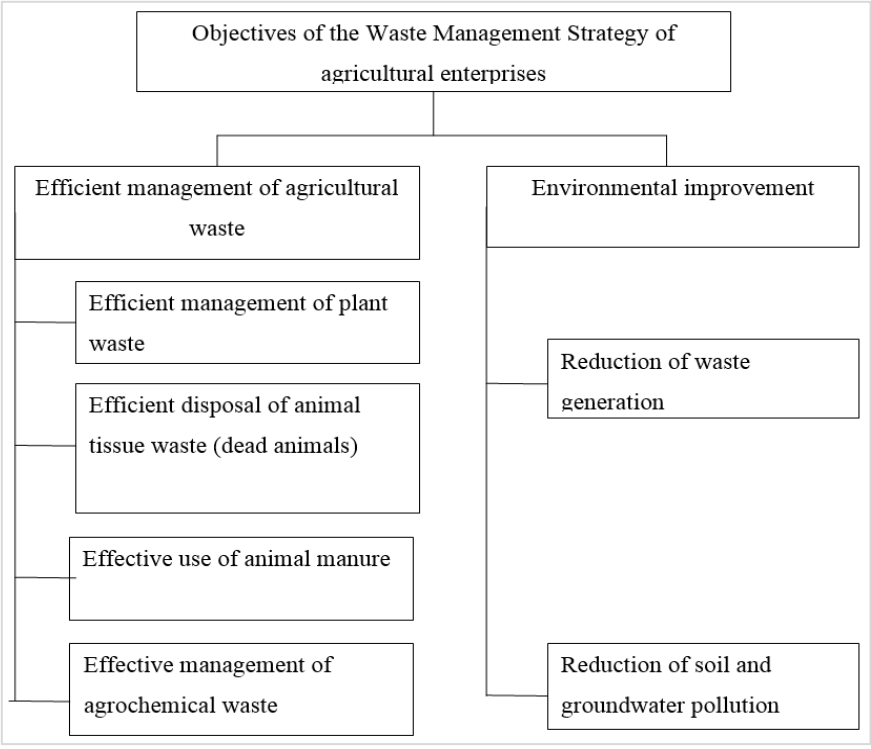

Table 1. Strategic and operational objectives of waste management of agricultural enterprises

Strategic objectives	Operational objectives
Efficient management of agricultural waste	Efficient management of plant waste
	Efficient disposal of animal tissue waste (dead animals)
	Effective use of animal manure
	Effective management of agrochemical waste
Environmental improvement	Reduction of waste generation
	Reduction of soil and groundwater pollution

Priority policy measures aimed at achieving the above operational objectives are presented in Tables 2-7.

Table 2. Priority policy measures for the management of plant waste

No.	Priority policy measures
1	Promoting scientific research on the calculation of the useful potential of crop waste
2	Excluding open burning of crop waste in the fields
3	Minimizing and, in the future, eliminating incineration of crop waste without obtaining energy
4	Promoting the development of crop waste logistics (storage, transportation) to stimulate its combustion together with coal at thermal power plants
5	Promoting the wider use of technologies for anaerobic digestion of crop waste or a mixture of crop and livestock waste with the production of biogas and its subsequent conversion into electricity and heat
6	Stimulating the energy use of waste (solid biofuels) to produce heat and electricity based on it
7	Promoting scientific research on the efficiency of the production of useful secondary non-energy products from crop waste: paper, wood replacement materials, cellulose, yeast, etc.
8	Stimulating the use of composting technologies for waste generated by small rural enterprises, while confirming the lack of economic benefits of anaerobic digestion technology
9	Developing compost standards and composting procedures for proper organization of the process and minimization of harmful environmental impacts
10	Providing subsidies to enterprises for the collection and transportation of crop waste that is suitable for the production of animal feed
11	Complying with sanitary and other requirements for the disposal of waste, if there are no other options for its effective management

Table 3. Priority policy measures for the disposal of dead animal tissue waste

No.	Priority policy measures
1	Ensuring strict compliance with laws and regulations concerning the processing of products, especially regarding the use of animal by-products
2	Disseminating information and knowledge about the disposal of animal tissue waste, including carcasses of small animals, as well as information about alternative disposal options, such as recycling, including technical and regulatory requirements
4	Disseminating information and knowledge about composting animal tissue waste, including carcasses of small animals. Implementation and enforcement of standards for composting and use
5	Studying the suitability of alternative disposal methods for implementation in Kazakhstan
6	Purchasing mobile incinerators and their installation in regional structures responsible for the supervision of the provision of veterinary services

Table 4. Priority policy measures for the use of animal manure

No.	Priority policy measures
1	Conducting a detailed analysis of the current situation with the removal of manure and its further processing/disposal
2	Developing requirements for handling manure at enterprises engaged in the maintenance of animals and birds
3	Improving regulatory framework governing the handling of manure, including storage, disposal, application rates per ha for various crops, application periods, and methods of application
4	Introducing modern manure application technologies, such as injections and gradual replacement of outdated equipment, and rejection of inefficient technologies
5	Organizing the collection of surplus manure where it is generated and redistribution to areas of organic fertilizer shortage
7	Stimulating the use of manure as a raw material for further use as organic fertilizer

Table 5. Priority policy measures for agrochemical waste management

No.	Priority policy measures
1	Storing pesticides only in specially designated warehouses with mandatory registration in a special journal
2	Developing special measures to combat counterfeit agrochemicals, increasing import control, and bringing violators to justice
3	Implementing measures for the protection of groundwater (waterproofing, selection of sites with a depth of groundwater of at least 2 m) when placing chemical treatment facilities (warehouses, mortar units, etc.)
4	Updating obsolete agrochemicals storages as necessary and developing a program for the purification and destruction of chemicals

No.	Priority policy measures
5	Categorically prohibiting the descent into reservoirs of uninfected collector drainage and wastewater generated when washing containers, machinery, equipment, vehicles, and workwear used when working with pesticides
6	Mandatory transferring of containers in which pesticides or agrochemicals were stored to specialized enterprises licensed to handle hazardous waste

Table 6. Priority policy measures to reduce waste generation

No.	Priority policy measures
1	Providing benefits in the taxation of products manufactured using waste
2	Priority state lending to entities implementing waste recycling lines
3	Government subsidies to reduce interest on bank loans related to investments directed at waste processing and the manufacture of appropriate equipment
4	Subsidies from the state budget and local budgets for secondary raw materials or semi-finished products obtained from these wastes
5	Providing information on the possibilities of recycling waste

Table 7. Priority policy measures to reduce soil and groundwater pollution

No.	Priority policy measures
1	Implementing systematic monitoring of the state of soils of agricultural lands carried out in the agrochemical service system since the pollution of the agricultural sphere is closely dependent on the nomenclature and volume of use of chemical plant protection products and mineral fertilizers
2	Strengthening the control of the state of soils and groundwater around the warehouses of pesticides and adjacent agricultural land
3	Solving the situation with unsuitable and prohibited pesticides
4	Applying nitrogen fertilizers in strict accordance with the needs of field crops following the main stages of organogenesis, using data from soil and plant diagnostics and paying attention to methods of fertilization

4. Discussion

According to the developed tree of goals of our Strategy, the first strategic goal is the effective management of agricultural waste by type, and the first operational goal is the effective management of plant waste.

Researchers (Kashina *et al.* 2022, 2413; Seidakhmetova *et al.* 2022, 1993; Sidorenko and Kutrovskii 2016) note that improper handling of plant waste can become a source of several problems, in particular: some agricultural enterprises burn crop waste, which leads to the release of harmful substances into the atmosphere, leading to fires, etc.; an unpleasant odor if the waste rots in the open air; contamination of surface and underground waters; the appearance of wastelands since waste leads to the emergence of plant diseases; loss of the economic benefit from the possible energy use of waste and the replacement of traditional energy carriers with biofuels.

Effective technologies for crop waste management include (Kuznetsova and Zinich 2021a, 210):

1. Composting (needs to develop quality standards for compost). The presentation of biomass on the soil surface is an inexpensive solution; it is advisable to use it if other methods are unavailable or costly.

2. Biomass as a raw material for the production of materials – used as bedding and animal feed (technologies that are not innovative) and material for production (paper, wood substitutes, cellulose, cardboard, yeast, citric acid, etc.).

3. Crop biomass as an energy source – construction of cogeneration plants operating on the biomass of plant origin and organization of production of solid biofuels from crop waste.

4. Burial is the least acceptable solution and should be minimized and gradually discontinued.

For the effective disposal of dead animal tissue waste, it is necessary to consider that the disposal of animal waste must be carried out by specialized enterprises (divisions) and cannot be carried out by enterprises producing animal products intended for human consumption (Yesil *et al.* 2014, 2132).

We agree with studies (Kolga and Kazarovets 2014; Siben and Nikonov 2022, 307) that fallen animals and other animal waste significantly affect the development of various diseases. Animal waste is prone to rot; thus, the materials must be processed considering the minimization of odors, insects, disease transmission, and the potential for environmental pollution. Fallen animals should be removed as soon as possible and disposed of following the approved procedure within one day.

According to scholars, systematic monitoring of the content of toxic elements and pesticides in the soils of agricultural lands is necessary for the effective management of agrochemical waste, which is the most important

task of environmental protection, since soil contamination with these elements can hurt the vital activity of soil microorganisms leading to a decrease in fertility (Grigoruk 2019, 18).

A wide range of chemicals is used in agriculture, including pesticides for plant protection, fertilizers and plant growth regulators, insecticides, and herbicides (Al-Yasari 2022, 678). It is necessary to pay attention to the import and use of counterfeit chemicals. In addition to the current use of agrochemicals, obsolete agrochemicals from the past form an environmental threat that needs to be addressed.

Pesticides were widely used in Kazakhstan up until the 1990s on almost the entire area of agricultural land in the country, covering about 21 million ha (Mustafina *et al.* 2020, 236). In addition, significant areas were contaminated with pesticide waste. According to the total reserves of persistent organic pollutants, Kazakhstan ranks second in the region after the Russian Federation (Mustafayeva *et al.* 2019, 161). Currently, about 1,021 trade names of pesticides of various applications and uses are registered in Kazakhstan, of which 386 contain one or more active substances included in the PAN list (Pesticide Action Network International 2009) prohibited for use, which is 38% of the total number of pesticides registered in the country.

Therefore, the use of pesticides should be organized in such a way as to prevent their entry into the air in concentrations that exceed the permissible ones and the accumulation of persistent and actively migrating pesticides in the soil, since scientific studies (Ibatullin *et al.* 2014, 38) show that pesticides can spread thousands of km in the environment, and the problem of the negative impact concerns everyone.

The second strategic goal of our Strategy is to improve the environment, the first operational goal of which is to reduce the volume of waste generation. According to the research results (Mustafayeva *et al.* 2019, 161), Kazakhstan actively pays attention to these issues. In this connection, waste management policy should be aimed at contributing to the closed-cycle economy by extracting high-quality resources from waste as much as possible, which is most consistent with the green economy.

Local executive authorities and self-government bodies in Kazakhstan may determine, within their powers, additional measures related to stimulating the recycling of waste and reducing the volume of their formation.

Regarding the goal of reducing soil and groundwater pollution, considering previous studies (Ivanova *et al.* 2022, 119), the following has to be said.

Reducing soil pollution should be solved in two ways, namely: prevention, of the entry of toxicants into the soil, as well as cleaning the soil of toxic substances.

Intensive technologies for growing field crops increase the possibility of soil contamination with fertilizer residues, pesticides, herbicides, and other toxicants. The presence of toxic substances in the soil is accompanied by their accumulation in food, feed, and surface and groundwater. Therefore, we need strict control over the correct use of fertilizers, pesticides, and chemical ameliorants. In particular, the use of mineral fertilizers is regulated by agrotechnical and hygienic standards: the rate of fertilizers per unit area and the ratio of nutrients for individual crops, the timing and methods of application, the maximum permissible level of nitrates and nitrites in crop production (Shevchenko *et al.* 2013, 17).

According to researchers (Foo and Hameed 2009, 39), the modern agroindustry is the main factor of water pollution in the world. The main substances that negatively affect water quality are fertilizers (mineral and organic), pesticides, herbicides, pathogens, and residues of medicines from animal husbandry, as well as waste processing. According to experts, water pollution with nitrates and other nutrients from the agricultural sector in the EU accounts for 50-80% of total water pollution (Foo and Hameed 2009, 39). No such studies have been conducted in Kazakhstan, but it is logical to assume that the content of nitrates and other nutrients in reservoirs is increasing.

As practice shows (Polushkina *et al.* 2020, 1081), prevention of groundwater pollution is a more effective method and, in some cases, the only one that is more economical and economically profitable in the long term. Pollution prevention measures in particular include (Mamin *et al.* 2013):

- rules for the safe handling of manure and volumes and conditions for the construction of tanks for its storage, which ensures that nitrates do not enter into the environment (Salkhozhayeva *et al.* 2022, 131);
- periods when the introduction of fertilizers into the soil is undesirable (winter and summer for Kazakhstan);
- restriction of fertilizer application for sites with a slope, located close to reservoirs or groundwater;
- optimal doses of fertilizers for different types of soils, climatic conditions, and types of crops;
- use of crop rotations to maintain soil quality;
- support of perennial plantings and vegetation cover, especially important in rainy periods when nutrients are washed out. The remnants of vegetation in the fields that are often burned (and thus create another problem for the environment) can retain nitrates.

Preventive measures are often not associated with technical modernization or other expensive measures; therefore, they are more affordable and adjust agricultural practices that maintain a balance between production and a good ecological condition of the area.

Conclusion

Today, waste is considered a valuable secondary resource, and technologies for its secondary use are actively developing. There is a need to improve the management of various types of waste in Kazakhstan, especially waste from agricultural enterprises, which have significant potential.

The implementation of the goals and measures provided for by our Strategy can become a significant basis for improving the environment through the effective disposal of agricultural waste and promote the use of crop production waste to produce secondary products.

The successful implementation of the Strategy requires a well-coordinated and thought-out state policy, directing efforts to popularize waste recycling and stimulating its effective use.

References

[1] Al-Yasari, M.N.H. 2022. Potassium and nano-copper fertilization effects on morphological and production traits of oat (Avena sativa L.). *SABRAO Journal of Breeding and Genetics,* 54(3): 678-85. DOI:http://doi.org/10.54910/sabrao2022.54.3.20

[2] Asim, N., *et al.* 2015. Agricultural solid wastes for green desiccant applications: an overview of research achievements, opportunities and perspectives. *Journal of Cleaner Production,* 91: 26-35.

[3] Bayazitova, Z.E., Kurmanbayeva, A.S., Tleuova, Z.O. and Temirbekova, N.G. 2023. Application of the thermophilic fermentation method to obtain environmentally friendly organic fertilizer. *Journal of Ecological Engineering,* 24(4): 202-16. DOI: https://doi.org/10.12911/22998993/159647

[4] Bezpalov, V.V., *et al.* 2023. Relationship between complex integration indices and inflation indicators and their impact on the development of regional cooperation between countries to reduce the level of inflationary risks: Case of the SCO member countries. *Risks* 11(1): 5. DOI: https://doi.org/10.3390/risks11010005

[5] Bruun, S., *et al.* 2006. Application of processed organic municipal solid waste on agricultural land - A scenario analysis. *Environmental Modelling and Assessment,* 3: 251-65.

[6] Foo, K.Y., and Hameed, B.H. 2009. Utilization of rice husk ash as novel adsorbent: A judicious recycling of the colloidal agricultural waste. *Advances in Colloid and Interface Science,* 1-2: 39-47.

[7] Ghisellini, P., Cialani, C. and Ulgiati, S. 2014. Review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production,* 114: 11-32.

[8] Grigoruk, V.V. 2019. Trends in organic diversification of agriculture in the world, developed countries and Kazakhstan. *Problemy agrorynka,* 3: 18-26. (in Russian)

[9] Ibatullin, U.G., Shatokhin, V.I. and Panchenko, I.P. 2014. A systematic approach to solving the problems of agro-industrial waste. *Ekologicheskii vestnik Rossii,* 6: 38-42. (in Russian)

[10] Isrun, U. 2021. Reduction in the emission rate of greenhouse gases and the increase in crop production by using compost on marginal land. *International Journal of Design & Nature and Ecodynamics,* 16(5): 583-91. DOI: https://doi.org/10.18280/ijdne.160513

[11] Ivanova, N.N., Ivanov, D.I., Zamotaeva, N.A. and Nedayborshch, J.N. 2022. Influence of the after effect of the main tillage methods on the water properties of the alluvial soil. *Research on Crops,* 23(1): 119-25. DOI:https://doi.org/10.31830/2348-7542.2022.017

[12] Jędrczak, A. 2018. Composting and fermentation of biowaste - Advantages, and disadvantages of processes. *Civil and Environmental Engineering Reports,* 28(4): 72-87.

[13] Kamenik, L.L. 2013. General directions of the Waste Management Strategy. *Ekonomika i upravlenie,* 12(98): 62-5. (in Russian)

[14] Kashina, E., *et al.* 2022. Impact of digital farming on sustainable development and planning in agriculture and increasing the competitiveness of the agricultural business. *International Journal of Sustainable Development and Planning,* 17(8): 2413-20. DOI: https://doi.org/10.18280/ijsdp.170808

[15] Khoruzhy, L.I., *et al.* 2022. Adaptive management reporting system in inter-organizational relations of agricultural enterprises according to ESG principles. *Journal of Infrastructure, Policy and Development,* 6(2): 1649. DOI: http://dx.doi.org/10.24294/jipd.v6i2.1649

[16] Khoruzhy, L.I., *et al.* 2023. Opportunities for the application of a model of cost management and reduction of risks in financial and economic activity based on the OLAP technology: The case of the agro-industrial sector of Russia. *Risks,* 11(1): 8. DOI: https://doi.org/10.3390/risks11010008

[17] Kolga, D.F., and Kazarovets, N.V. 2014. New Technologies and Technical Means of Manure Disposal at Livestock Farms and Complexes]. Minsk: BGATU, 144 p. (in Russian)

[18] Kuldybayev, N., *et al.* 2021. Effects of root rot in soybean cultivars with diverse susceptibility to the disease on plant physiology, yield, amino acids and mycotoxins profile in climatic conditions of Kazakhstan. *OnLine Journal of Biological Sciences,* 21(4): 312-21. DOI: https://doi.org/10.3844/ojbsci.2021.312.321

[19] Kulshikova, E., Zhayliev, A., Yerekeshova, A. and Kalieva, S. 2023. Evaluation of solar radiation and atmospheric air during hay harvesting in Kazakhstan. *OnLine Journal of Biological Sciences,* 23(1): 65-70. DOI: https://doi.org/10.3844/ojbsci.2023.65.70

[20] Kuznetsova, N.A., and Zinich, L.V. 2021a. Recycling of crop waste as a factor in improving the efficiency of agricultural enterprises. *Biznes. Obrazovanie. Pravo,* 1(54): 210-4. (in Russian)

[21] Kuznetsova, N.A., and Zinich, L.V. 2021b. Recycling of waste as a factor in the sustainable development of agricultural enterprises. *Fundamentalnye issledovaniya,* 11: 120-4. (in Russian)

[22] Lansing, S., Martin, J.F. and Botero, R.B. 2006. Waste treatment and biogas quality in small-scale agricultural digesters. *Bioresource Technology,* 13: 5881-90.

[23] Mamin, R.G., Vetrova, T.P. and Shilova, L.A. 2013. Innovative Waste Management Mechanisms. Moscow: MSUCE, 136 p. (in Russian)

[24] Martirosyan, A.V., Ilyushin, Y.V. and Afanaseva, O.V. 2022. Development of a distributed mathematical model and control system for reducing pollution risk in mineral water aquifer systems. *Water,* 14: 151. DOI:https://doi.org/10.3390/w14020151

[25] Mustafayeva, B., *et al.* 2019. The impact of agricultural environmental pollutions on the population's quality of life. The experience of Kazakhstan. *Journal of Environmental Management and Tourism, 10*(1): 161-70. DOI:https://doi.org/10.14505//jemt.10.1(33).16

[26] Mustafina, V.V., Dushkina, Yu.N., Argynbaeva, E.M. and Gor., N.V. 2020. Highly hazardous pesticides in Kazakhstan: Current situation and recommendations for minimizing negative impacts. *Khimicheskaya bezopasnost,* 4(1): 236-47. (in Russian)

[27] Omodero, C.O. 2021. Fiscal decentralization and environmental pollution control. *International Journal of Sustainable Development and Planning,* 16(7): 1379-84. DOI: https://doi.org/10.18280/ijsdp.160718

[28] Polushkina, T., *et al.* 2020. Development of organic agriculture in the European Union member states: The role of public-private partnership. *Journal of Environmental Management and Tourism,* 11(5): 1081-94.

[29] Salkhozhayeva, G.M., Abdiyeva, K.M., Arystanova, Sh.Y. and Ultanbekova, G.D. 2022. Technological process of anaerobic digestion of cattle manure in a bioenergy plant. *Journal of Ecological Engineering,* 23(7): 131-42. DOI: https://doi.org/10.12911/22998993/149516

[30] Sammoudi, R., *et al.* 2023. Bacteriological quality status of spring waters from the Taanzoult plain (Aguelmam Sidi Ali Wetland, Morocco). *Journal of Ecological Engineering,* 24(4): 184-91. DOI:https://doi.org/10.12911/22998993/159634

[31] Seidakhmetova, A., *et al.* 2022. Development of ecosystem stability as a tool for managing agricultural areas in the Republic of Kazakhstan: Problems and opportunities for their resolution. *Journal of Environmental Management and Tourism,* 13(7): 1993-2001. DOI: https://doi.org/10.14505/jemt.v13.7(63).19

[32] Shamtsyan, M.M., Kolesnikov, B.A., Klepikov, A.A. and Kasyan, O.V. 2011. Biotechnological processing of agricultural and food industry waste. *Rossiiskii khimicheskii zhurnal,* 55(1): 17-25. (in Russian)

[33] Shevchenko, T.I., Solyanik, O.N. and Vishnitskaya, E.I. 2013. Waste management practices in developed countries. *Izvestiya Yugo-Zapadnogo gosudarstvennogo universiteta,* 2(47): 17-24. (in Russian)

[34] Siben, A.N., and Nikonov, A.A.2022. Reindeer infestation with *Cysticercus Tarandi* in the tundra of Yamalia, Russia. *American Journal of Animal and Veterinary Sciences,* 17(4): 307-13. DOI:https://doi.org/10.3844/ajavsp.2022.307.313

[35] Sidorenko, O.D., and Kutrovskii, V.N. 2016. Bioconversion of Agro-Industrial Waste: A Tutorial. Moscow: INFRA-M, 160 p. (in Russian)

[36] Yesil, H., Tugtas, A.E., Bayrakdar, A. and Calli, B. 2014. Anaerobic fermentation of organic solid wastes: Volatile fatty acid production and separation. *Water Science & Technology,* 69(10): 2132-8.

[37] Zhang, Z., Gonzalez A.M., Davies, *E.G.*R. and Liu, Y. 2012. Agricultural wastes. *Water Environment Research,* 84(10): 1386-406.

[38] Pesticide Action Network International. 2009. PAN International List of Highly Hazardous Pesticides (PAN HHP List). Hamburg. Available at: http://www.pan-germany.org/download/PAN_HHP-list_russ_100301.pdf

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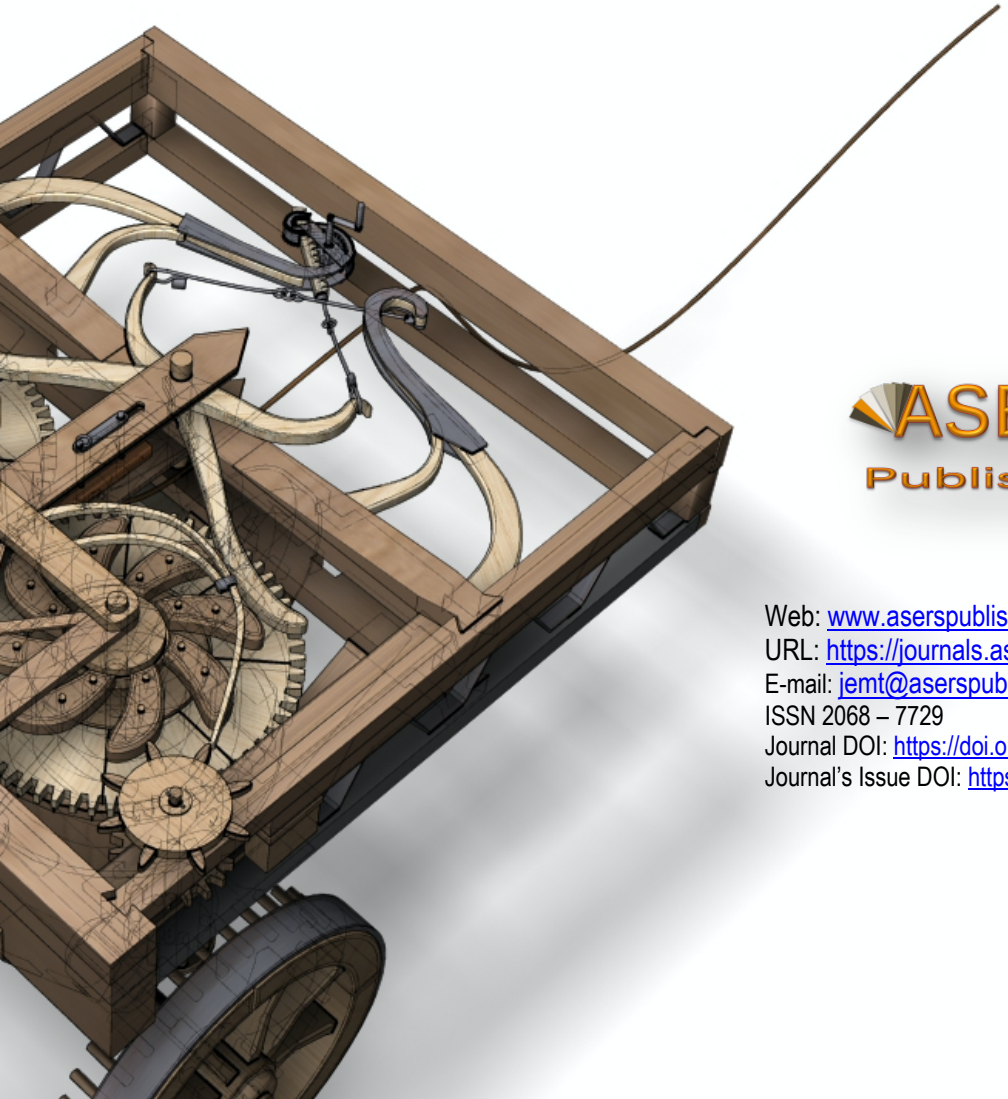

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