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## **CLEAN TECHNOLOGIES AS AN INSTRUMENT FOR IMPROVEMENT OF COMPETITIVENESS OF AGRO-INDUSTRIAL COMPLEX**

The article is devoted to the research of the issue of implementation of clean technologies in agro-industrial complex as an instrument for improvement its competitiveness. It is established that environmental protection is inseparable from the restructuring of the system of economic relations, since the economic and ecological components of the existence of society form a single indivisible system. Nowadays, most of the natural resources become waste that are not used rationally. Agro-industrial complex is one of the material-rich and multi-purpose sectors of the national economy. To overcome the negative situation prevailing over the last decades in the field of waste management, it is necessary to find the most appropriate means. It is proved that one of the necessary instruments for improving the competitiveness of products of agro-industrial complex is clean technology. Five general principles of cleaner production are considered: input-substitution, good housekeeping, internal recycling, technological optimization/change, optimization of the product. The purpose of clean production is to achieve and maintain a balance of economic, environmental and social aspects of economic entities.

**Keywords:** agro-industrial complex, cleaner production, competitiveness of agro-industrial complex, environmental protection, sustainable development.

**Problem statement.** The gap between consumption and available resources of the Earth increases in the negative side every year, demonstrating the rapid growth of human needs in conditions of limited resources. Humanity has always used the environment mainly as a source of resources, but for a very long time such activity did not affect the state of the biosphere. However, in the twentieth century changes in the biosphere became catastrophic. Trying to constantly improve its existence, a person continues to increase the pace of material production, without thinking about the inevitable harmful consequences for the person and the biosphere. As a result of misuse of the biosphere, the state of the environment is extremely bad, and this has become one of the greatest challenges of our time for the whole of humanity.

In the 60's and 70's of the twentieth century, humanity realized the need to preserve the balance between economics and the environment and began to develop the idea of a World Strategy for Nature Conservation. In 1992, the United Nations Conference on Environment and Development adopted a strategy for sustainable development, based on the idea of a balance between the environment and its resources, economy and population of the Earth. The goal of the Strategy for Sustainable Development is to develop the main ways and means of adapting life to global change. In accordance with this goal, everyone has the right to a clean environment, to a fruitful life in harmony with nature.

The efforts to minimize the environmental impacts of production processes, products and services during the last decades has clearly been supported by an increased commitment of governments and industry to environmental protection. The underlying agenda is the development of strategies for sustainable development in business and in society at large<sup>1</sup>. However, there is a great distance from the strategy of sustainable development to an effective system of its implementation. The weak degree of implementation of the principles of the concept of sustainable development manifests itself in increasing the technogenic load on the environment and its degradation. The task of developing effective instrument for sustainable development is still unresolved.

Environmental protection is inseparable from the restructuring of the system of economic relations, because the economic and ecological components of the existence of society form a single indivisible

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<sup>1</sup> Nilsson, L., Persson, P.O., Rydén, L., Darozhka, S., Zaliauskiene, A. (2007). *Cleaner Production – Technologies and Tools for Resource Efficient Production*. Baltic University Press, 17.

system. Understanding the scale and nature of environmental problems, their interrelation with the state of the national economy allows determining the appropriate resources for their solution. Society can develop only at the expense of the resources of the natural environment, most of which are not boundless and urgent tasks of humanity is their rational use, preservation and restoration. However, nowadays most of the natural resources become waste that are not used rationally.

Agro-industrial complex is one of the material-rich and multi-purpose sectors of the national economy. Most agricultural products constitute an excessive flow of waste. To overcome the negative situation prevailing over the last decades in the field of waste management, it is necessary to find the most appropriate means. The link between nature and economic activity and the main means of balancing them is clean production. The purpose of clean production is to achieve the fullest use of natural resources, while simultaneously caring for future generations.

**Analysis of the last researches and writings.** The problems of waste management in the context of environmental protection were considered in were considered in writings of I. Aleksandrov, K. Baretta, K. Boulding, S. Garmash, N. Golikova, Z. Gutsaylyuk, O. Derikolenko, P. Aikins, T. Zhelezna, Y. Lebedinsky, R. Lohr, O. Maley, V. Kerzhakov, N. Pirogov, I. Sotnik, S. Soloviev, K. Ferucci, M. Chumachenko etc.

At the same time, the issue of strengthening the competitiveness of agro-industrial complex through the prism of the problems of clean technologies in the conditions of modern socio-economic development of Ukraine requires more attention.

**The aim of the article.** The purpose of the paper is to study the problem of implementation of clean technologies in agro-industrial complex as an instrument for improvement its competitiveness.

**Basic results of the research.** The environment is actively involved in the process of production of material goods not only as a supplier of natural resources, but also as a factor of production. As a result, there is a tendency for deterioration of indicators characterizing the state of the environment, which becomes a limiting factor in the economic and social development of society, especially in conditions of extensive agriculture<sup>1</sup>.

Global agriculture is particularly challenged by the United Nations Sustainable Development Goals (SDG) for 2030<sup>2</sup>. While agriculture should contribute towards SDG 1, 2, 3 (no poverty, zero hunger, good health and well-being), it has to support SDG 12, 13, 14 and 15 (responsible consumption and production, climate action, life below water, life on land) at the same time. In particular, agriculture is one of the most significant sectors in terms of climate and energy consumption. Globally, agriculture contributes 10%–12% of total anthropogenic greenhouse gas (GHG) emissions and 56% of the non-CO<sub>2</sub> GHG emissions, mainly due to nitrous oxide emissions from soils and methane emissions from cattle. In addition to greenhouse gas emissions and energy consumption, agriculture is the single largest consumer of water in most countries, and is accordingly also a significant source of water pollution. These dependencies and externalities force agriculture to improve its production and become cleaner by using fewer resources and causing fewer emissions. In addition, higher productivity is widely demanded from agriculture, in order to cope with an increasing world population and food demands. That means two major goals have to be reached, ideally without trade-offs. A successful implementation of clean technologies, which are commonly defined as “means of providing a human benefit which, overall, uses less resources and causes less damage than alternative means with which it is economically competitive”, could support the transition of the global agricultural system towards these goals<sup>3</sup>.

Note that the launch of the Pollution Prevention Pays program in 1974 is generally regarded as the first landmark on the road towards Cleaner Production. The 3P program was unique in its recognition of the importance of process and product innovation for achieving the dual objectives of enhancing competitiveness and reducing environmental impacts. The initial concepts of cleaner production were

<sup>1</sup> Елкина, Л.Г. (2009). *Управление развитием эколого-экономической системы промышленного предприятия*. Автореферат диссертации на соискание ученой степени доктора экономических наук, 08.00.05, Уфимский государственный авиационный технологический университет. Уфа, 15.

<sup>2</sup> United Nations (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development A/RES/70/1*. <<https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>> (2018, January, 15).

<sup>3</sup> Scharfy, D., Boccali, N., Stucki, M. (2017). *Clean Technologies in Agriculture. – How to Prioritise Measures?* <<http://www.mdpi.com/2071-1050/9/8/1303/pdf>>. (2018, January, 15).

assembled during the mid-1980's, but the establishment of the Cleaner Production Program at the United Nations Environment Program in 1989 provides a commonly recognized historical mark for the formal launch of the concept<sup>1</sup>.

UNEP has been successful in proposing Cleaner Production as an overarching concept, and in building consensus on its operational definition. UNEP definition on Cleaner Production is as following: Cleaner production is the continues application of an integrated preventive strategy applied to products, production and service for enhancing effectiveness which reduces risks to human and environment and increases economic benefits. For production processes, Cleaner Production involves conserving raw materials and energy and eliminating toxic raw materials, reducing the quantity and toxicity of all emissions and wastes before they leave the process. For products, Cleaner Production involves reducing negative impacts along the life cycle of a product, from raw materials extraction to its ultimate disposal. For services, Cleaner Production involves incorporating 2 environmental concerns into designing and delivering services. Cleaner Production requires changing attitudes, applying know how and improving technology<sup>2</sup>.

The concept of Cleaner Production became a program of action with two specific objectives:

1. Improving eco-efficiency of production in the short- and medium- term.
2. Long-term dematerialization.

Globally, the process of adopting cleaner technologies is part of the sustainable development policy defined in Agenda 21, adopted in Rio de Janeiro in 1992, in that it promotes and encourages the adoption of new manufacturing processes that make scale economies of both raw materials and energy, and are cleaner with regard to environmental protection and adjacent populations. The concept of cleaner production is well-known in industrial environmental management. Clean production is an integrated approach to production, constantly asking what happens throughout the life cycle of the chemical or product. It is necessary to think in terms of integrated systems, which is how the living world functions<sup>3</sup>.

There are a number of broadly synonymous concepts that describe this drive towards sustainability. UNEP has coined the term *Cleaner Production (CP)* to describe the concept, US-EPA calls it *Pollution Prevention (P<sup>2</sup>)*, the World Business Council for Sustainable Development (WBCSD) uses the term *Eco-efficiency* and other institutions use terms such as *waste minimisation* and *green productivity* to describe more or less the same concept. A more recent concept is that of *Zero Emission*, adopted as a vision and a target by industrial sectors such as the Pulp and Paper Industry, as well as by the research community in e.g. the Global ZERI Network (Zero Emissions Research & Initiatives). It is meant to go beyond Cleaner Production, by being more comprehensive and making all resources useful. A Technology Platform for Zero Emission Fossil Fuel Power Plants is developed within the EU Seventh Framework Programme. The concept of *Industrial symbiosis*, or *Industrial ecology* is even more comprehensive, in that it optimises the industrial system as a whole or a considerable set of industries<sup>4</sup>.

Cleaner Production describes a preventative approach to environmental management. It is neither a legal nor a scientific definition to be dissected, analyzed or subjected to theoretical disputes. It rather refers to a mentality of how goods and services are produced with minimum environmental impact under current technological and economic limitations<sup>5</sup>.

Cleaner Production requires that resources be managed efficiently. This consists both of careful use of resources, the closing of material streams, and resource substitution. It is possible to outline five general principles of Cleaner Production:

1. *Input-Substitution* Use of less hazardous raw-, auxiliary- or operating materials. Use of operating materials with a longer lifetime.

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<sup>1</sup> Yi, Q. (2003). Cleaner Production and Circular Economy – New Strategy For Environment and Development in China. <[http://mail.neaef.org/pubs/neaef16/1-4\\_Yi.pdf](http://mail.neaef.org/pubs/neaef16/1-4_Yi.pdf)>. (2018, January, 15).

<sup>2</sup> Yi, Q. (2003). Cleaner Production and Circular Economy – New Strategy For Environment and Development in China <[http://mail.neaef.org/pubs/neaef16/1-4\\_Yi.pdf](http://mail.neaef.org/pubs/neaef16/1-4_Yi.pdf)>. (2018, January, 15).

<sup>3</sup> Pubule, J. (2014). *Cleaner production in biowaste management. Doctoral Thesis in Power and Electrical Engineering*. Riga, 34.

<sup>4</sup> Nilsson, L., Persson, P.O., Rydén, L., Darozhka, S., Zaliauskiene, A. (2007). *Cleaner Production – Technologies and Tools for Resource Efficient Production*. Baltic University Press, 17.

<sup>5</sup> Nilsson, L., Persson, P.O., Rydén, L., Darozhka, S., Zaliauskiene, A. (2007). *Cleaner Production – Technologies and Tools for Resource Efficient Production*. Baltic University Press, 17.

2. *Good Housekeeping* Increase the Material and Energy efficiency of actions in the process. Try to fetch the “low hanging fruits” first, e.g. reduce losses due to leakage. It is important to train employees.

3. *Internal Recycling* Close Material and Energy Loops for water, solvents, etc. Cascading of Material and Energy streams.

4. *Technological Optimisation/Change* Implementation of new technologies. Improved process control. Redesign of processes. Change in or substitution of hazardous processes.

5. *Optimisation of the Product* Increasing the lifetime. Easier repair. Easier de-manufacturing, recycling or deposition. Use of non-hazardous materials<sup>1</sup>.

CP itself is not a solution to all environmental problems, but it reduces the dependence on end-of-pipe solutions, generates less harmful wastes. Products that are designed and produced with CP in mind are often less harmful for consumers to use, and their residuals are normally less of a burden to waste streams. Apart from the environmental benefits, CP practice also offers the organization with financial gains. CP strategies are assuming significance in most industries including the agro based industries<sup>2</sup>.

Pollution problems in agro-based industry are caused mainly due to the energy consumption; wastewater and solid wastes generated during their manufacturing processes and air pollution problems are caused by combustion processes. Assessment of CP enables to recognise and examine the CP opportunities which can make possible their implementation in industries. The assessment consists of identification of sources of wastes and emissions through an audit to be conducted on resource consumption; impact on environment. Further, comparing with best performing unit provides an opportunity to understand the shortcomings and get new ideas to improve and perform better<sup>3</sup>.

In the application of Cleaner Production Policy to the Agriculture the areas where the attention has to be paid are increasing environment friendly agro- productions, minimization of environmental pollution due to the use of agro-chemicals, marketing management, correct policies and planning, accurate land management, development of soil conservation methods for agricultural lands and delivery of agricultural production to the market under the production label of environment<sup>4</sup>.

In the absence of modern clean technologies, the competitiveness of agro-industrial sector is hampered. Competitiveness is a multi-faceted concept, that depends on the degree of intensity of competition, market conditions, advertising activities, management level and maintenance.

Despite the large number of factors that affect the competitiveness of agro-industrial complex, the main and determining factor of these remains the ability to produce competitive products and create conditions for its promotion on the market.

One of the necessary instruments for improving the competitiveness of products of agro-industrial complex is clean technology. For example, integrated pest management is a cleaner production technology, developed for pollution prevention and control in agriculture in the 1970's. Since then its usefulness has been demonstrated in most countries, for example with cost savings of 37%–53% in South Africa. A further example is agricultural biogas, which became popular as a renewable form of energy production on a small-scale household-level in the 1970's in India and China and on an industrial scale in the 1980's in Europe, particularly in Germany. Biogas production from agricultural wastes, i.e., animal manure, harvest residues or slaughter wastes, combines waste treatment with energy production, which makes it very attractive for agriculture. More recently, the Clean Development Mechanism offers the possibility for developed countries to account reduced carbon emissions by implementing measures in less-developed and thus less-expensive countries. Dechezleprêtre, Glachant & Ménière analysed Clean Development Mechanism projects and showed that in the agricultural sector, 105 projects, which transferred GHG emission reduction technology from industrial countries to less-developed countries, were registered by 2007. This number

<sup>1</sup> Nilsson, L., Persson, P.O., Rydén, L., Darozhka, S., Zaliauskiene, A. (2007). *Cleaner Production – Technologies and Tools for Resource Efficient Production*. Baltic University Press, 23.

<sup>2</sup> Basappaji, K.M., Nagesha, N. (2014). Assessment of cleaner production level in agro based industries – a fuzzy logic approach. *Energy Procedia*, vol. 54, 128.

<sup>3</sup> Basappaji, K.M., Nagesha, N. (2014). Assessment of cleaner production level in agro based industries – a fuzzy logic approach. *Energy Procedia*, vol. 54, 128.

<sup>4</sup> Ministry of Agriculture of Democratic Socialist Republic of Sri Lanka (2012). *National policy and strategy on cleaner production for agriculture sector*. <<http://www.environmentmin.gov.lk/web/images/pdf/national%20policy%20and%20strategy%20on%20cleaner%20production%20for%20agriculture%20sector%20english.pdf>> (2018, January, 17).

increased up to 959 projects by 2010, as reported in Larson, Dinar & Frisbie. This development shows that there is a growing market for cleaner production in agriculture<sup>1</sup>.

Cleaner Production does not deny growth; it merely implies that growth should be ecologically sustainable. It should not be considered only as an environmental strategy, because it also relates to economic considerations in determining the optimal way of producing a product or a service. In this context, waste may be considered as a “product” with negative economic value. Each action to reduce consumption of raw materials and energy, and prevent or reduce generation of waste, can increase productivity and bring financial benefits to an enterprise. Cleaner Production is a “win-win” or even “win-win-win” strategy. It protects the environment, the consumer and the worker while improving industrial efficiency, profitability, and competitiveness<sup>2</sup>.

Cleaner Production is a strategy towards achieving sustainable production, reducing wastes and emissions at the source and is distinct from end-of-pipe technologies. Despite the advantages of Cleaner Production, there are some barriers that are active making its worldwide implementation difficult. Major barriers to the implementation of Cleaner Production are lack of knowledge of the appropriate technology, lack of technical expertise in the methodology of process assessment and diagnosis, lack of financial resources, lack of awareness, government policies and regulations, incentives for investment in end-of pipe technologies and resistance to new ideas<sup>3</sup>.

Therefore, further development of clean technologies in the field of agro-industrial complex is possible on the basis of balanced steps aimed at increasing the volume of competitiveness as a driving force for the development of economic actors in agro-industrial complex. This will contribute to strengthening the industrial base of agro-industrial complex, the development of the industrial and scientific and technical potential of the country, strengthening the material situation and living conditions of industry workers, preserving food security of the state.

**Conclusions.** The gap between the volume of accumulation of agro-industrial waste and measures aimed at preventing their secondary use, processing, utilization, etc., exacerbates the ecological crisis and becomes an inhibitory factor of economic development of the country. Ukraine needs urgent reform of the legal and economic system that regulates the use of waste, including agro-industrial complex as one of the key sectors of the economy of our country, taking into account international and European experience. Necessary requirement to manage modern agro-industrial production is the desire for sustainable and stable development which involves achieving and maintaining a balance of economic, environmental and social aspects of economic entities. To reorganize production in the agro-industrial complex of Ukraine, a set of legal, economic, organizational, administrative and technological measures should be taken.

The interconnection of the effectiveness of agro-industrial production with the potential deterioration of the quality of the environment has become more pronounced with increasing intensity of methods of agro-industrial production. All negative impacts on the environment can be significantly reduced or completely eliminated by changing the production technologies in AIC, in particular, after applying clean agricultural production. This will allow maintaining a balance between agro-industry and the state of the environment, which will allow obtaining a sufficient quantity of agricultural products, an acceptable income for producers of such products and an optimal environment for the population.

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<sup>3</sup> United Nations Industrial Development Organization (1995). *NGO Forum on Cleaner Industrial Production ID/WG.544/I*. <<https://ru.scribd.com/document/5045899/cleaner-industrial-production-kyoto>> (2018, January, 18).

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