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Effective Management of Production Clusters in the Context of an Innovative Economy

Turayeva Nargiza^{1*}, G. Kuchkarov²

¹ PhD student at Karshi State University

² Professor

* Correspondence: autor@gmail.com

Abstract: The paper explores the possible approach to the management of production clusters through the prism of the concept of an innovative economy, especially in context of the ongoing transformation to circular economy principles. The paper illustrates expanding need in quick urbanisation, industrialisation and waste growth for this contemporary management strategies to be built-in into the cluster improvement. The choice of priority directions in the field of waste management is indicated, the methodological approaches necessary to ensure sustainable development are substantiated, the organizational and economic tools that improve the coordination of cluster participants are improving. Research focuses on the problems of developing sustainability strategies for industrial entities, of methodological improvement of eco certification systems for secondary products, services and creation of new environmentally oriented products and services. Moreover, it shows that the areas of regulation include regional level landfilling and waste disposal site, as well as electronic platforms providing real time access to statistics within the circular economy. Complementing this, the use of econometric models to predict future variables are also seen as vital to sound decision making. Analysis is done within the framework of ongoing reforms in the Republic of Uzbekistan aimed at enhancing waste management and environmental protection, boosting waste recycling capabilities, and attracting investment into waste to energy and recycling projects. Results show that the adoption of circular economy strategies in production clusters leads to better resource efficiency, lower environmental impact and better socio-economic results. In general, the research substantiates that modern innovative model of management production clusters as an essential condition for economic competitiveness, environmental safety and spatial reality balance of the national economies

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Introduction

At present, due to global urbanization, rapid industrialization, and the continuous growth of consumption, the worldwide generation of municipal solid waste has reached an alarming scale. More than 2 billion tons of municipal solid waste are generated globally each year, and this figure

is expected to increase by approximately 70 percent by 2050. The majority of this growth will occur in developing countries, primarily as a result of inadequate access to reliable waste collection services, limited waste segregation at source, and a heavy reliance on uncontrolled landfills and open dumps [1]. These factors lead to the accumulation of hazardous and toxic waste, environmental contamination, water pollution, threats to public health, and the acceleration of climate change.

For instance, in Latin America and the Caribbean, nearly 145,000 tons of waste per day—approximately one-third of all urban waste—are disposed of in open dumps. It must be acknowledged that waste management is generally not perceived as an attractive topic. Indeed, even within international debates on climate change and development, waste-related issues have rarely occupied a central place on the agenda. However, if meaningful progress is to be achieved in addressing the global crises of climate change, environmental pollution, and biodiversity loss, it is essential to intensify discussions on waste and to implement more effective actions at both global and local levels.

Literature review. Innovation is a process of managing the development of existing systems, through which an innovative product is brought to the stage of practical application and achieves market success. Assessments of national competitiveness indicate that innovation serves as a core development strategy for enterprises and supports the implementation of management policies based on the following principles: rational use of natural and climatic resources; efficient utilization of accumulated assets; active attraction of investments; and support for innovation.

One of the most important practical objectives of innovative activity is the formation of an effective system for implementing innovation processes. This requires the development of a theoretical framework for innovation activity, the justification of methods for solving existing problems in the field of innovation, and the elaboration of methodologies for assessing the effectiveness of innovation processes along with tools for influencing them [2]. There is an object to create value based on invention, and its effectiveness is determined with the methods and approaches applied when exercising innovation strategies, developing certain category and types of innovations and maximizing the effects of integrating research and development outputs into production and practical use. Above all, it includes key approaches for both the establishment and implementation of innovation-focused solutions, and management techniques for executing these strategies in particular organizational arrangements.

Innovation theory and methodology of innovation strategy have been studied since early XX century and have been considered by leading researchers. Today, demand and research and development have led to new demands on product range and quality, thus altering the supply/demand relationship in response to scientific and technological progress. In order to differentiate the principles and classifications of innovative activity; in the first place, it is necessary to carry out a thorough analysis of the economic essence and content of the definition of the term “innovation”.

In economic literature, innovation is defined as the transformation of potential scientific and technological progress into real development in the form of new products and technologies [3]. In market economies, the systematic presentation of innovations is based on international standards, according to which innovation is understood as the result of innovative activity manifested in a new or improved product introduced to the market, a new or improved technological process applied in practice, or a novel approach to social services.

Despite the extensive body of research conducted on this issue, there is still no universally accepted and unified terminology in the field of innovative activity. Therefore, a brief review of the relevant scientific literature and clarification of the key concepts in innovation studies are warranted [4]. The main stages of the development of innovation theory are associated with the works of scholars such as W. Sombart, W. Mitchell, and J. Schumpeter. One of the most important economic contributions was made by the Austrian economist Joseph Schumpeter, in the 1930s by introducing the concept of innovation. He stressed that innovation is something that comes

from the application of new or improved technical, technological and organizational solutions in production, distribution and supply.

Schumpeter's notion of innovation is focused on the idea that innovation involves new combinations of factors of production, and this forms part of one of the two most prominent schools in innovation theory. The former is explaining the use of new factors of production, whilst the latter is about the newly create product and technology. In the classical work *The Theory of Economic Development*, Schumpeter (2014) identified five dimensions of change driven by innovation: the formas of new methods of production or the empire of production in response to market forces; diversification of products with new features; use of new raw materials for production; change in management methods for the organization of production; and the emergence of new consumer markets.

The second approach to the concept of innovation is based on the use of specific types of new equipment, technologies, and other products in production [5]. According to this perspective, some scholars consider innovation as an integral component of production activity from both innovative and scientific-technical viewpoints. Consequently, innovation is understood both as a process and as an outcome. Taking into account the need to ensure the economic efficiency of innovations, several Russian economists define innovation as a new product or service, production method, or organizational, financial, research, or other type of novelty that ensures cost savings or creates conditions for such savings.

Research methodology. This study focuses on improving organizational and economic mechanisms aimed at enhancing the effectiveness of managing production clusters in the context of an innovative economy. The research is directed toward the development of an innovative management model that ensures sustainable development, efficient resource utilization, and improved coordination among cluster participants.

Analysis and results. Waste comprises around 20 per cent of global anthropogenic methane emissions. Since methane is nearly 80 times as worse as carbon dioxide, unmanaged waste continues to have a dire impact on the environment and economy, making the United Nations Sustainable Development Goals targets even more out of reach. Meanwhile, the ever-increasing amount of plastic rubbish — empty water bottles, Bags, and other containers — is a big part of the trash present in rivers and the oceans, which can threaten marine and coastal ecosystems. According to UNESCO, plastic pollution results in the deaths of more than one million seabirds and over 100,000 marine mammals annually.

Despite the severity of this scenario, waste-related challenges are largely solvable. Unlike many complex climate and development issues that require major technological breakthroughs, scalable solutions for reducing pollution and methane emissions from waste are already available in practice [6]. They are founded on a circular philosophy that seeks to reduce, reuse, recycle, regenerate and recover energy, striving to ensure production and consumption processes have the smallest possible environmental impact. In addition, they provide access to jobs and create new business opportunities that can lift entire communities.

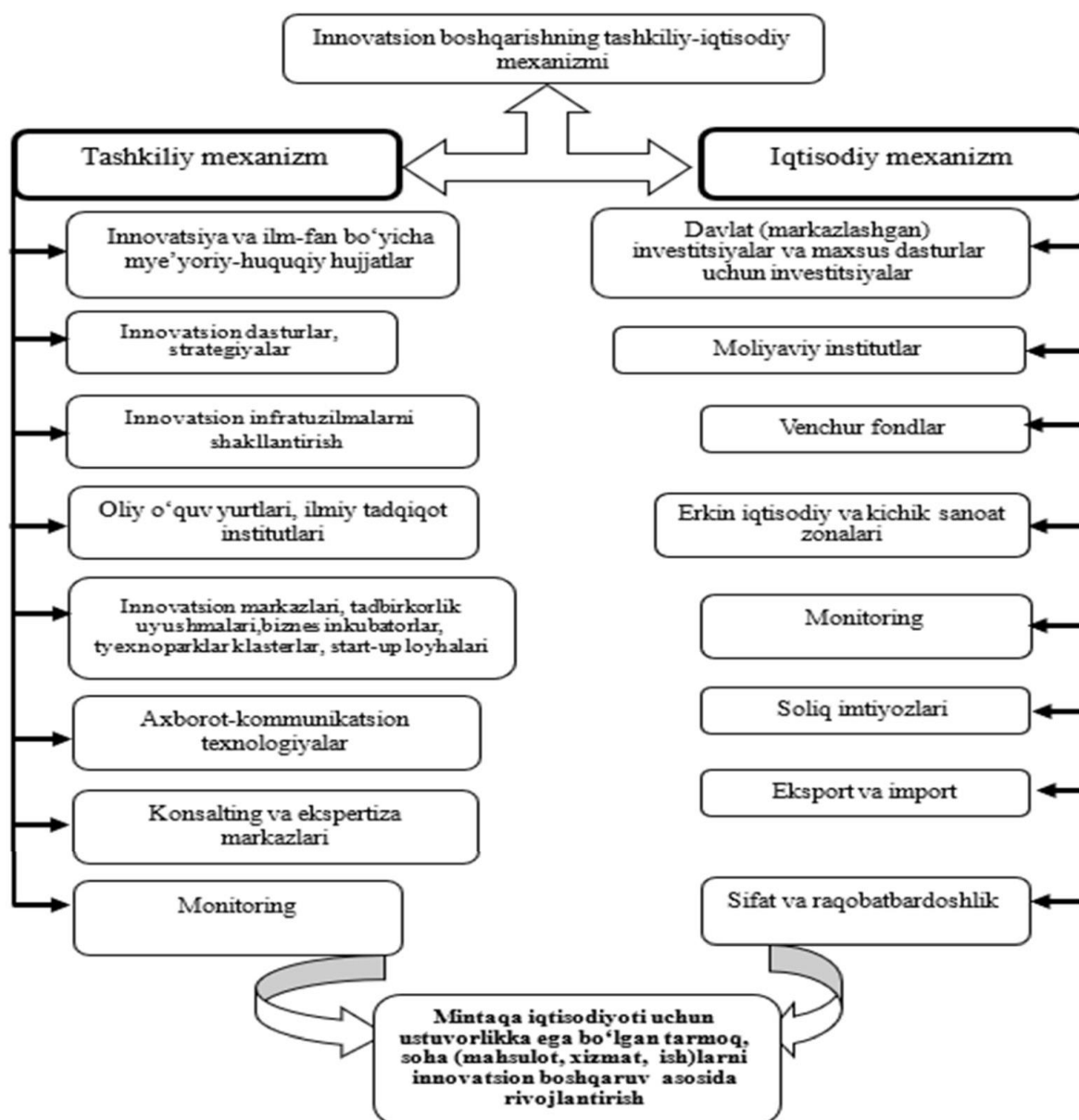
The circular pathways start with enhanced systems for collecting waste: along with the broadening of the sorting and reprocessing facilities for plastics, glasses, and metals, as well as composting and energy recovery for biowaste. This lowers the amount of trash going to the landfills and creates new sources of revenue for municipalities and waste management companies to pay back the investments for upgrading infrastructure. They allow producers to lower CO₂ emissions by validating the requirement of new raw materials and energy. Sanitary landfills with methane emissions capture and utilization systems are considered much better for pollution containment and climate change impacts compared to open dumps.

Over 14 million tons of waste is produced a year in Uzbekistan, but the share of recycling is only 4–5 percent of this volume [7]. As a result, over 7 million tonnes of greenhouse gases are emitted from waste dumps every year while an estimated 43,000 tonnes of toxic leachate leaks

into the ground over the years. By recycling waste, the adverse effect can be limited and the possibility of boosting the economy increases.

In this context, these indicators reflect their impact on the environmental condition, sustainable economic growth, and social changes within the process of sustainable development. Therefore, addressing waste management challenges within a circular economy framework oriented toward sustainable development not only creates new opportunities for entrepreneurs but also plays a crucial role in stimulating the economic growth of regions.

Figure 1. Main Elements of the Organizational and Economic Mechanism of Innovative Management



At the global level, under the conditions of an innovative (circular) economy, extensive scientific research is being conducted to enhance the potential of waste recycling by improving socio-economic principles aimed at ensuring the sustainable development of the sector in regions, developing models that meet environmental requirements, and refining methodologies focused on protecting the interests of local communities (Figure 1). In this context, particular attention is given to identifying the key directions of waste management, substantiating methodological approaches, developing sustainability strategies for sectoral entities, improving

the methodological foundations of eco-certification for secondary products and services, creating new products and services, and determining priority areas for regulating landfills and dumps in regions [8]. In addition, emphasis is placed on launching electronic platforms that enable real-time access to statistical data in the circular economy industry, as well as forecasting prospective indicators using econometric models. In New Uzbekistan, targeted programs and measures are being implemented in order to ensure rapid development of the circular economy and to increase transparency in this area in accordance with the advanced international standards, as well as to develop sustainable tourism through the efficient use of country available resources. For this purpose the year 2025 was declared as the "Year of Environmental Protection and Green Economy" with the ultimate goal of forming a system built on the harmony between man and nature. Waste recycling is seen as an important solution not only for environmental sustainability but also for economic sustainability. To implement these goals, the Ministry of Ecology, Environmental Protection, and Climate Change has developed a number of large-scale projects in collaboration with foreign investors. These projects plan to attract around USD 1.3 billion in investments, build eight waste incineration plants as well as landfill gas treatment at the Ohangaron landfill site.

For example, China's CAMC Engineering plans to invest USD 350 million in the construction of two plants in Andijan and Tashkent regions. These facilities will process 4,000 tons of waste per day and generate 630 million kilowatt-hours of electricity annually. Another Chinese company, Shanghai SUS Environment, has expressed interest by committing USD 310 million in direct investment to build two plants in Samarkand and Kashkadarya regions. These plants will process 3,000 tons of waste per day and produce 480 million kilowatt-hours of electricity per year. Additionally, the UAE-based Tadweer Group will invest USD 200 million to construct a plant serving Bukhara and Navoi regions, with a capacity to process 1,500 tons of waste per day and generate 363 million kilowatt-hours of electricity annually [9]. A project involving South Korea's Sejin company is also of significant importance. Under this initiative, USD 55 million will be invested to generate alternative electricity from landfill gas at the municipal solid waste landfill in Ohangaron district of Tashkent region, with a planned capacity of 16 megawatts.

Overall, these projects will ensure the rational utilization of municipal solid waste. More than 4.7 million tons of waste will be incinerated annually, generating approximately 2.1 billion kilowatt-hours of electricity, with electricity sales valued at USD 97 million. Furthermore, the projects are expected to save 152 million cubic meters of natural gas, reduce greenhouse gas emissions by 2.4 million tons, and create 1,200 new jobs [10]. The implementation of these projects is planned for 2025–2027 across Andijan, Bukhara, Jizzakh, Kashkadarya, Navoi, Namangan, Samarkand, Syrdarya, Fergana, Tashkent regions, and the city of Tashkent. The Head of State has placed particular emphasis on the social significance of these projects. *"These are not merely industrial facilities; they represent one of the critical issues determining our very survival. The suitability of land and water resources, public health, air quality, and energy security are all directly linked to this sector. If waste is properly collected and recycled on a larger scale, ecological balance will improve, the environment will become cleaner, and society itself will undergo positive transformation,"* emphasized *Shavkat Mirziyoyev*.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total number of organizations performing R&D	301	317	313	304	360	323	437	389	668	304	254
1) Including:											
Research activities	237	259	247	251	259	267	313	284	456	195	195
of which: fundamental research	111	114	121	105	113	124	133	118	188	113	112

Design, engineering, and technological activities	25	23	19	23	31	31	31	31	54	28	17
Experimental production of prototypes, pilot batches, and products	13	18	13	10	11	14	20	19	33	16	9
Design works for construction	4	5	6	6	10	13	10	8	33	6	6
Scientific and technical services	63	62	73	58	41	66	143	118	219	126	91
Volume of Completed Research and Experimental Development (R&D), million UZS	127992,0	162695,8	202402,2	244345,4	280603,4	339856,9	426122,9	449905,4	680038,0	853404,4	992029,1
Including:											

Table 1. Research and Experimental Development (R&D) by Type of Scientific Activity

Therefore, responsible authorities were instructed to treat these projects as model initiatives and replicate them across regions. At present, investors and manufacturers primarily focus on ensuring stable energy supply for their enterprises. In this regard, it has been emphasized that locating new enterprises—such as producers of construction materials and organic fertilizers—near waste recycling plants is economically feasible (Table 1). This approach is beneficial for both entrepreneurs and investors. Accordingly, a task has been set to develop a “roadmap” for scaling up and ensuring balanced development of such projects across all regions [11].

In Uzbekistan, this sector has been undergoing consistent improvement. By the Presidential Decree of the Republic of Uzbekistan dated September 26 of the current year, the Agency for Waste Management and Circular Economy Development was established. The Agency is responsible for introducing modern methods of waste collection, sorting, neutralization, recycling, incineration, utilization, and disposal. Through the development of a circular economy in this field, the environmental situation is expected to stabilize, sanitary conditions to improve, and the spread of environmentally related diseases among the population to decrease. The process of recycling industrial and municipal waste leads the generation of another energy, secondary raw materials and organic fertilizers [12]. Since areas of existing waste landfills are also planned to form eco-industrial zones

To overcome these challenges, it should be necessary to establish production clusters built from “circular economy” principles with the support of modern management. The linear model of the economy, in which economic activity is based on the principle of “take–make–dispose” dominates in many countries. This has led to a growing interest in reconceptualizing the conventional economic paradigm and shifting to a circular economy approach based on the take–make–reuse principle (Gottfried, A closed-loop economy (also known as a circular, cyclical, or closed-cycle economy)) is, most experts say, the way to reconcile economic growth with sustainability.

For many years, nature and the economy have been in conflict, and it has been impossible to prioritize one side without causing harm to the other. The circular economy represents a regenerative or restorative production system. This approach is often associated with related concepts such as the green economy, closed economy, and zero-waste economy. It implies replacing the concept of “planned obsolescence,” shifting focus toward renewable energy sources, completely eliminating the use of toxic chemicals that hinder product reuse, and

reducing waste through improvements in design, materials, products, and ultimately entire business models.

In industrialized countries, waste-intensive lifestyles have contributed to ecosystem degradation, resource depletion, and increasing climate instability. At the same time, population growth and rising per capita incomes in low-income countries exert additional pressure on limited resources. Business communities often perceive environmental policy development as a threat to competitiveness; however, there is substantial justification for viewing resource efficiency as an opportunity. The current economy is largely built on a “fast turnover” principle, whereby rapid replacement of consumer goods benefits producers, resulting in inefficient management of Earth’s resources [13].

Transitioning to a circular economy through reuse offers significant advantages. According to the European Commission’s 1981 report *“Jobs for Tomorrow: The Potential for Substituting Manpower for Energy”*, unlike the production of new goods, the circular economy creates local jobs while reducing resource consumption, greenhouse gas emissions, and waste generation. The conclusions of this report remain relevant today. The economic effectiveness of implementing the circular economy concept is reflected in reduced consumption of raw materials and energy resources, leading to decreased demand and lower price volatility in resource markets, as well as job creation through the emergence of new circular economy sectors [14].

Accelerated urbanization encourages governments to promote the development of the circular economy. For enterprises, the benefits include strengthened relationships with partners along the entire value chain, increased innovation capacity and customer loyalty, additional competitive advantages, and the emergence of new revenue streams [15]. For consumers, these benefits are reflected in access to environmentally friendly products and, in some cases, reduced prices. The circular economy provides a framework for reusing material resources within existing production cycles, resulting in a range of positive and negative effects. However, despite certain adverse impacts, empirical evidence suggests that the overall benefits of developing a circular economy significantly outweigh the associated costs.

Along with the long-term benefits of transitioning to a circular economy, a number of challenges also exist, including:

- difficulties in stimulating systemic changes;
- economic constraints (the circular economy may be unprofitable in the short term);
- imperfect markets (lack of necessary products and infrastructure, insufficient competition, limited knowledge and/or incentives);
- imperfect regulation (inadequate legislation and/or weak implementation mechanisms);
- social factors (insufficient knowledge and skills related to the circular economy);
- difficulties in accessing adequate financing;
- lack of harmonized regulations across different sectors.

The implementation of a circular economy requires comprehensive changes throughout the entire “product life-cycle cost” chain, aimed at identifying and utilizing reserves in the use of material resources. Such changes are complex in nature and cannot be achieved solely through technological solutions; they also require profound economic and organizational transformations.

Conclusion. In general, the application of a circular economy model is considered an appropriate and effective approach to enhancing the management efficiency of production clusters. As a result, as indicated in the author’s conceptual framework, the three pillars of sustainability—economic, environmental, and social sustainability—can be ensured within society. Achieving sustainability is possible only when a balance and mutual coherence among these three dimensions are established.

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