

## ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF AGROINDUSTRIAL ENTERPRISES.

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**Abstract:** This study presents scientific and practical ideas on the need and methods for assessing the environmental impact of agro-industry. It briefly discusses the environmental impact of current agro-industrial enterprises in our country.

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**Keywords:** agro-industry; environment; technologies; GIS; digitalization; green economy

### Introduction.

In recent years, Uzbekistan's agro-industrial complex has undergone rapid growth. The adoption of new technologies, increased production volumes, and broader export potential are crucial for the economy. At the same time, it has become urgent to assess how this development impacts the ecological balance. Minimising the negative effects of agro-industrial enterprises on the environment and following sustainable development principles are among the most important priorities today.

### Literature review

Malmström, B. and Davis, C. (2020) "Pesticides and Environmental Hazards: Impacts on Soil and Water Resources" analyse the negative impact of pesticides and fertilisers on the environment. Cameron, J., Walker, M. (2019) "Agricultural Sustainability and Resource Conservation" emphasises the importance of sustainable agriculture and rational use of resources. Bersamin, A. and Kurbaniyazov, R. (2023) "Environmental Impact of Agro-Industrial Enterprises in Uzbekistan and Strategies for Sustainable Development" discusses the scientific basis and practice of environmental impact assessment. Rashidov, A. and Shukurov, M. (2020) "Energy and Water Efficiency of the Agro-Industrial Sector" offers practical recommendations for conserving water resources and the efficient use of water in agriculture in Central Asia.

### Analysis and result.

Environmental impact assessment of agro-industrial enterprises is vital for ensuring environmental safety, the rational use of natural resources, and sustainable development. Agro-industrial enterprises operating in Uzbekistan,

including cotton and textile factories, meat and dairy processing plants, food canneries, and chemical fertiliser production facilities, cause several major environmental problems. Emissions into the atmosphere from fuel products and gases generated during processing contribute to air pollution. Impact on water resources occurs when chemicals and waste used in production contaminate water sources, reducing the quality of drinking and irrigation water. Improper disposal of solid and liquid industrial waste leads to soil and groundwater pollution. Excessive use of pesticides and mineral fertilisers accelerates soil degradation and harms biodiversity.

Currently, the environmental impacts of large-scale industrial enterprises include:

1. Impact on the atmosphere. Emissions of greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O), particularly from livestock farming and fertiliser application; dust, ammonia, and other harmful gases; air pollution caused by tractors and agricultural machinery.

2. Impact on water resources. Water wastage due to inefficient irrigation; water pollution from pesticides and fertilisers; groundwater contamination from livestock waste.

3. Impact on land resources. Soil erosion through wind or water; soil salinisation or compaction; chemical pollution of soil.

4. Impact on biodiversity. Reduced biodiversity caused by pesticides and monocultures; ecosystem degradation such as deforestation. To evaluate the environmental impact of agro-industry, it is first essential to establish its criteria.

The impact of agro-industry on the environment can be assessed through the following methods.

1. Monitoring: through laboratory tests of atmospheric, water, and soil samples.

2. Model analysis: based on GIS (geographic information systems), LCA (life cycle analysis).

3. Sociological surveys: by identifying the opinions of residents on environmental problems.

4. State control: through reports of environmental protection authorities.

Digital monitoring and geo-information systems are currently widely used in Uzbekistan to assess the impact of agro-industrial enterprises on the environment, and they are as follows.

**Table 1. Evaluation criteria (key indicators)**

Direction	Evaluation indicator	Measurement
Atmosphere	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O emissions	tons/year
Water	Amount of pesticide/fertilizer residues	mg/l
Soil	Salinity level, erosion rate	% or points
Hazardous waste	Quantity, storage condition	tons/year
Energy	Renewable energy share	%
Ecosystem	Diversity index, lost flora/fauna	number of species

*GIS and situational maps.* The GIS platform, introduced by the Ministry of Agriculture in 2021, provides real-time field monitoring, satellite imagery analytics, meteorological data, and crop health status.

*Agroplatform & E-Lease.* The agroplatform, which covers more than 44,000 farmers, has automated the processes of land allocation, loans, insurance, and monitoring, and “E-Lease” has taken control of the electronic lease of land.

*Digitisation Centre.* The “Agroindustry Digitisation Centre” is implementing land and water resource management, smart agriculture, and drone monitoring technologies.

As a result, pesticide level analysis, bee monitoring (mainly for agriculture), and testing water-saving technologies (for irrigation systems) have been introduced.

A comparative analysis of the environmental impact assessment of current Uzbek agroindustry enterprises is presented in the table below.

Let's get acquainted with current and relevant statistics on the impact of Uzbekistan's agro-industrial enterprises and the agricultural sector on the environment.

**Table 2. Methods for assessing the environmental impact of agro-industrial enterprises**

Aspect	Current status	Recommendations
Comprehensive monitoring	GIS and drones, satellites are being covered by confusion	Integration and cooperation across regions — e.g. Drip + GIS + Drone
Experience and expertise	There are successes in the examples of Farmonaut and Living Labs	Expand the system to other regions, and implement pilot projects with local accelerators
Technological infrastructure	There are independent drone clusters and a national data centre	Integrate with IoT sensors, AI-enabled re-technologies
Inter-institutional cooperation	Exchange of experience with FAO and international institutions	Mapping between academics and manufacturers

*The table was prepared by the author.*

Irrigated agricultural land uses 90% of water resources, with an average of 46.7 km<sup>3</sup> of water used per year. Uzbekistan uses 58% of its land area for agriculture (26.2 million ha), of which 21.2 million ha are pastures. Almost 70% of pastures are degraded, and the former lands are turning into deserts. [11] Approximately 44% of irrigated land is considered to be highly saline. In 1990–2000, soil quality decreased from 58 points to 55 points; in Karakalpakstan, this indicator was only 41 points. In the long term, 3 million ha of land are subject to erosion (under the influence of air or water), with an annual loss of 80 tons of fertile soil. Agricultural activity accounts for 54% of the land area contaminated with pesticides; 80% of the land is highly contaminated. [7] Fuel combustion in agriculture and industry releases greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) and other air pollutants into the atmosphere. Heavy industrial emissions and transport also play a significant role.

In Uzbekistan, agricultural activity places significant environmental pressure on land and resources. There are persistent problems such as soil erosion, salinisation, and chemical pollution. Environmental damage associated with inefficient water use and waste disposal hurts economic benefits. Soil salinisation and degradation lead to an annual loss of US\$31 million in natural resources. Land abandonment causes another US\$12 million in losses. [3] Several efforts are being made to reduce these negative impacts, including:

In 2025 has been declared the “Year of Environmental Protection and Green Economy”. FAO and other organisations are implementing practical projects aimed at agricultural sustainability through pesticide-free, biopesticide approaches. [5] The 2023 “Sustainability through Agriculture-Energy Integration” projects are trying to popularise solar, wind and biomass energy. [6] By 2030, it is planned to introduce modern water-saving irrigation systems and reduce water consumption. [1] Public funds and international loans (World Bank, EBRD, etc.) have been attracted.

### **Proposal and conclusions.**

Proposals to reduce the environmental impact of agro-industrial enterprises and ensure sustainable ecological development include scientific, practical and political approaches.

In the direction of strengthening ecological monitoring and control. Introduce ecological monitoring at all stages of the activities of agro-industrial enterprises. Regularly measure the amount of pollutants in air, water and soil. Strengthen local ecological laboratories in material and technical terms.

In the direction of rational use of water resources. Provide subsidies for the introduction of drip irrigation and other water-saving technologies. Make water recycling and treatment systems mandatory at each large agro-industrial facility. Control water consumption through water meters and digital monitoring systems. [9]

In the direction of maintaining and increasing soil fertility. Encourage the planting of bio-salt-removing crops (e.g., alfalfa, lupine) to combat salinisation. Limit irrigation in areas at risk of erosion and restore alien plants and wild ground cover. Expand the use of organic and biohumus fertilisers instead of chemical fertilisers. [8]

In the direction of waste processing and ecological technologies. Support projects for biogas production from livestock waste. Provide subsidised equipment for converting cotton fibre, sunflower stalks, manure and other organic waste into compost. Introduce a system for the separate collection and disposal of hazardous waste, such as plastic and pesticide packaging.

In the direction of green energy and energy efficiency. Provide tax incentives for the introduction of solar panels, wind turbines and biogas equipment in agro-industrial facilities. Reduce the energy consumption of agricultural machinery and encourage the transition to EV technologies. [12]

In the direction of increasing environmental awareness for farmers and enterprise employees. Establish special training courses for farmers, agro-enterprise managers and workers on reducing environmental impact. Introduce environmental management certification and the “Green Enterprise” rating.

In the direction of digitisation and open environmental reporting. Each agro-industrial enterprise should be obliged to publish environmental reports. The state and the public should have free access to environmental information (for example, on waste, water, and air quality). [10]

Based on the above, the following conclusions can be drawn.

1. Although the agro-industrial sector is one of the main pillars of economic growth in Uzbekistan, it is exerting serious pressure on the environment. These pollutions lead to the long-term depletion of land and water resources.

2. In order to achieve environmental sustainability, enterprises operating in the sector must introduce modern, environmentally friendly technologies. This is done through state policy, legislation and investment.

3. Degradation of soil and water resources threatens not only agricultural productivity, but also

the entire ecosystem. To combat this, it is necessary to act on the basis of a scientific approach and best practices.

4. Excessive use of pesticides and chemical fertilisers directly affects human health and the quality of drinking water.

5. The active participation of local authorities, non-governmental organisations, scientific institutions and international partners is necessary in solving environmental problems.

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