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ENVIRONMENTAL THREATS TO FOOD SECURITY: PESTEL ANALYSIS ON THE BASIS OF SCIENTIFIC ASSESSMENT

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Abstract. *Ensuring food security requires your address environmental challenge. This study analyzes the major environmental issues affecting food security in Uzbekistan, including water resource depletion, so keep to fail degradation, climate change, and waste management. A PESTEL analysis was conducted to examine the political, economic, social, technological, environmental, and legal aspects of the abuse, not challenge. The result indicate the need for implementing a modern, resource-efficient technologies, support your eco-friendly food production, and adopting international standard. The study proposes innovative approaches and strategic measures to enhance food security.*

Keywords: *Food security, environmental issues, sustainable agriculture, PESTEL analysis, water resource, so keep to fail degradation, waste management, climate change, environment, innovative technologies, food production, eco-friendly products, international standards, legal regulations, environmental policy.*

1. Introduction

Food security is to ensure global problem that is climate change, water resources depletion, soil degradation and pollution of its main threat is. Drought, forest reduction and biodiversity , the loss of productivity to a decrease in lead has. Industrial waste and pesticides, soil and water quality. Sustainable agriculture economic, environmental clean technologies and waste re - use of important strategies listed. Food safety ensure to international cooperation, the green economy and innovative approaches to develop it is necessary. These problems are ignored, leave serious crisis out comeadi.

The world economy food security an important role to play in the global food market in 2023 10 trillion dollars reached (FAO/WHO, 2020). Climate change as a result of 2050 year to go and the rural economy work out of 10-25% reduction projected being (united nations, 2023). Currently

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800 million more human starvation from the suffer, the year of 2050 to go while this number is 2 billion to be reached can (AGE, 2022). The rural economy global water resources, 70% than more consume making (OECD-FAO, 2018-2027). Developed countries per year , an increase of 1.3 billion tons of food waste being (FAO, 2022). Food security, ensure to sustainable rural economy and innovative technology is important (Paris agreement, 2015).

Uzbekistan Republic President 2022-year 28-January “2022 — 2026-year designed the new uzbekistan's development strategy on” PF-60-the number of the resolution with the approved “2022-2026 to designed New uzbekistan's development strategy” in the framework of food food safety and environmental problems of the country development strategy priority areas one as identified. Climate change, water scarcity and soil degradation in the country of the rural economy to the stability of serious risk poses. 2022-2026-year - designed strategy within the framework of water - saving technologies, organic farming, agricultural clusters and green economy principles constitute development. Rural agriculture products export to increase sustainable food supply to create and ecological environment, to improve an important task as shown.

Literature review

Food safety in ensuring sustainability principles to follow to be an important process is it health to maintain and the environment the impact reduce to the great importance it has. This direction F. Lopez-Galvez, p. a. Gómez, F. Artés, F. Artés-Hernández and E. Aguayo (2021) “Interactions between Microbial Food Safety and Environmental Sustainability in the Fresh Product Supply cha let” called research identified fresh fruit and vegetables supply chain in the microbiological safety and environmental sustainability between connection illuminated. Research food waste reduction, water resources use, transport and packaging of the process of security and stability effects of the analysis was. Additionally, microbiological safety ensuring with along with the environmental sustainability enhancing aimed at the innovative strategies and scientific basis of the review out (Lopez-Galvez and other., 2021).

K. Nadiradze and N. Phirosmanashvili (2014) “Food Safety and Environmental Problem” called research identified food security threat governing environmental problems, in particular, pollution, pesticides and the effects of Gm constantly and LMO'larning risk assessment of the issues illuminated. Research food products safety increase to monitoring systems, quality control, music approaches and global food security problem to a solution as the environmental aspect of

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sustainable agricultural management practices importance revealed (Nadiradze and Phirosmanashvili, 2014).

T. Varzakas and S. Smaoui (2024) “Global Food Security and Sustainability Issues: The Road to 2030 from Nutrition and Sustainable Health Diet to Food Systems Change” called research identified food security and the stability ensure to food system change and the problems illuminated. Research food waste,and climate change, rural agriculture and fish farming systems for sustainable development, as well as healthy and sustainable as the dieta through food security, to ensure the methods discussed are. The authors of the food system of transformative out increase to innovative approaches, new protein sources and resources for effective use , the need for have noted (Varzakas and Smaoui, 2024).

A. Baikadamova, Y. Yevlampiyeva, D. Orynbekov and others (2024) “The Effectiveness of Implementing the HACCP System to Ensure the Quality of Food Products in the region with Ecological Problem” called research identified In kazakhstan, located on the small meat processing processing enterprises ; HACCP system effectiveness is studied. Research lead, which arsenic, radionuclides (Cs-137) , such as pollutants ingredients control to for HACCP plan work out and this process of security standards compliance evaluated. The conclusion ,according HACCP system heavy metals and pesticides , the amount of reducing effective ,to be the environmental aspect of the complex in the territory of food security in ensuring an important role plays (Baikadamova and other., 2024).

S. do not ji, F. Wang, K. Li and others (2021) “Environment and Food Safety: A Novella that integrativ Review” called research identified food safety and environmental pollution between link to a scientific analysis made. Research dirty substances in food products ,the effects mikroplastikalar, heavy metals and pesticides on human health to risk of the discussion was. Also, research on food safety , ensuring for environmental clean food packaging materials, biosensorlar and dirty the ingredients of quick detection technology importance given showing (do not ji and other., 2021).

U. Sheripbaeva (2024) “Global climate changes in the context of food security ensuring and sustainable development directions” called research identified global climate changes as a result of the water resources scarcity, land degradation and agricultural sector development, economic and legal aspects of the analysis has been. Research food safety ensure to fertile and resistant crop varieties ,the creation of modern irrigation technologies introduction to agroklasterlar and

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environmental clean work out methods of expansion of the necessity illuminated (Sheripbaeva, 2024).

Methodology

Food safety in ensuring environmental problems solve to on the research in a comprehensive and systematic approach is required to. This issue any way to learn to PESTEL analysis method to be applied should. This method of food safety and environmental sustainability with the associated problems of political (P), economic (E), social (S), technological (T), environmental (E) and legal (L) aspects of the analysis to make the possibility of returns.

PESTEL analysis through food safety problems of various factors related each - way price, year, comprehensive and research - based solutions to work out the possibility it creates.

PESTEL analysis of expert assessment by done increase to mathematical modeling and rating methods apply. These methods are each a factor of food security impact on the level of more accurate assessment help it.

Expert valuation 4 stages out carried.

♦ Dastali, Experts selection, that is, the field on the experts (the agronomist,the environmentalists, food security on experts, economists, technologists) attract dosh required are.

♦ The next stage is analysis of factors set out is carried. Thus, PESTEL analysis on each a category for the main criteria is determined. In the third stage ekspertlardan score the assessments of the collection out ,carried this stage, each a factor of 1 from 10 to the scale will be evaluated. Each factor on the cost calculation is performed by the following formula: $S_{,grated} = \frac{\sum_{k=1}^{n} X_{grated}}{n}$

This here:

- S_{grated} – i-factor of the j-category of expert cost
- $X_{we\ have\ grated}$ – i-factor for k-eksert by have been put points
- n – experts the number of

♦ Expert reviewsnini to get in the fourth stage, her a factor of the overall effect of the level of determine in order to weight factor calculation is carried out.

PESTEL analysis of every one of the structural part of food safety to different effect makes. This is the reason for the factors of weight, the price is given to:

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$$W_{\text{grated}} = \frac{S_{grated}}{\sum_{j=1}^{m} S_{grated}}$$

This here:

- W_{grated} – j-category of the total cost share
- m – PESTEL analysis on common factors , the number of

♦ Results synthesis for the purpose of the final PESTEL index is. Each a category on taken of the price and their weight into account ,taking the total PESTEL index is determineby the following formula sh is performed:

$$\text{PESTEL} = \sum_{j=1}^{m} (W_{grated} \times S_{grated})$$

Results interpretation:

- **0 - 3 points**: Low impact – food security, less influence which factors.
- **4 - 6 points**: Average effect – important, but the solution is working is not.
- **7 - 10 points**: High impact – food security is a significant impact , which has a factor.

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Political factors (P - Political)

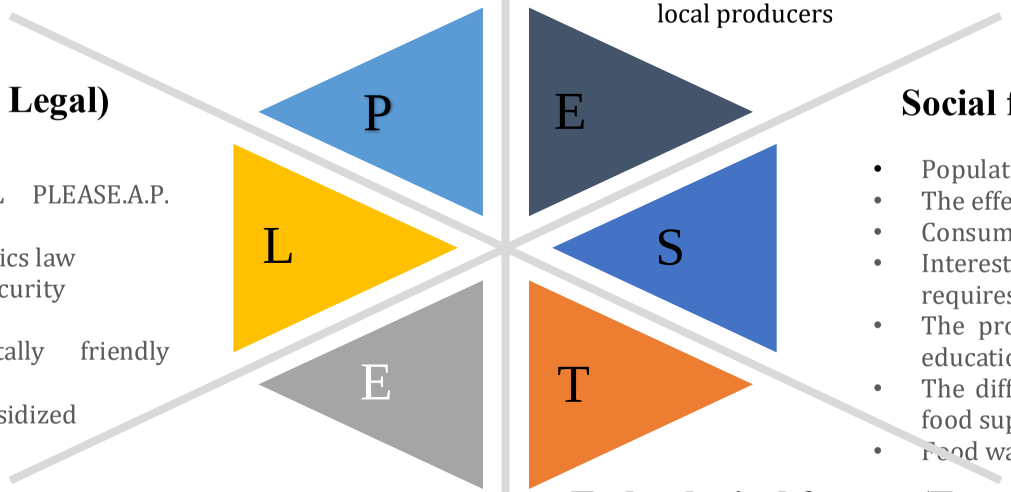
- The national food security strategy
- Food security of the state, subsidized
- Environmental standards and legislation
- Cooperation with international organizations
- Water and land resources management policy
- State programs on adaptation to climate change
- Regulation of agricultural export and import

Economic factors (E - Economic)

- The rural economy, the volume of investments in
- The price of food products and Inflatsiya
- The demand for environmentally friendly products and the price difference
- The effectiveness of the use of resources
- The costs of production
- The shortage of labor force and migration
- Foreign investment and technology transfer programs to support local producers

Legal factors (L - Legal)

- HACCP, ISO 22000, GLOBAL PLEASE.A.P. certificates
- The rural environmental economics law
- Normative documents on food security
- The law of farms and the earth
- Certification of environmentally friendly products
- Environmental taxes and are subsidized



Social factors (S - Social)

- Population growth and food demand
- The effects on the health of the population
- Consumer culture and the habits of nutrition
- Interest in organic and environmental products requires.
- The professionalism of the staff and level of education in agriculture
- The difference in urban and rural areas of the food supply
- Food waste and waste management

Environmental factors (e - environment)

- Climate change and productivity
- Depletion of water resources and pollution
- Soil degradation and salinity
- Air pollution and food safety
- Contamination with heavy metals and pesticides
- The decline of biological diversity
- Agricultural waste management

Technological factors (T - Technological)

- Water-saving technologies
- Agrobiotexnologiyalar
- Production and processing technologies are chiqindili
- Smart rural economic systems
- Environmentally friendly packaging technologies
- Transport and logistics systems
- Genetic modifikatsiyalangan body (GM) issue

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Fig.1. Environmental problems in uzbekistan in the conditions of ensuring food security and PESTEL analysis for the evaluation of strategies to solve them

Analysis and results

The RRepublic of Uzbekistan in the conditions of food security in ensuring the environmental problems and them solve to strategies of assessment for PESTEL analysis on expert assessment out was carried out. The assessment results according to any one factor effect the level of its general PESTEL to the index of the added contribution and food security with associated most important problems you will define.

Experts by political (P), economic (E), social (S), technological (T), environmental (E) and legal (L) factors on 1 from 10 to the scale in the price was given. Any one factor, the effect of the level and the weight factor is.

PESTEL factors	Expert 1	Expert 2	Expert 3	Expert average cost (S_{grated})	Weight factor (W_{grated})	the final effect level ($W_{grated} \times S_{grated}$)
Political (P)	8	7	9	8.00	0.19	1.52
Economic (E)	9	8	9	8.67	0.21	1.82
Social (S)	7	6	8	7.00	0.17	1.19
Technological (T)	6	5	7	6.00	0.15	0.90
Environmental (E)	9	9	10	9.33	0.22	2.05
Legal (L)	5	6	6	5.67	0.12	0.68

The final PESTEL index is:

$$PESTEL=1.52+1.82+1.19+0.90+2.05+0.68=8.16$$

PESTEL index 8.16 if this Uzbekistan food security problems, environmental problems have a strong effect that has shows. Including:

1. The most important factor is the environmental factor is (W_E=0.22, S_E=9.33, the overall effect 2.05). Water resources depletion, soil degradation, and climate change food security is a serious risk poses. Therefore ,for sustainable irrigation systems development agroekologik technologies introduction to and are chiqindili work out of the method implementation to significant strategic direction is.

2. Economic factors also have a large effect having (W_E=0.21, S_E=8.67, the overall effect 1.82). Food production, production costs increase, local work , including out of support , and environmentally clean products on the market important economic factor is. Investment attract to and environmental and rural agricultural development for tax benefits and state subsidized the expansion required is.

3. Political factors high rated (W_P=0.19, S_P=8.00, the overall effect 1.52). Uzbekistan government food security to ensure on a number of strategies have received have ,although their effectiveness increase to international cooperation ,enhancing national environmental legislation, the modernization of to and food safety on the monitoring of the system improvement is necessary.

4. Social factors (W_S=0.17, S_S=7.00, the overall effect 1.19). Environmentally clean products for the demand increasing , growing ,although the population among sustainable food consumption and waste reduction a culture of development for education and propaganda to the program, a need exists.

5. Technological factors average level of affect will (W_T=0.15, $S_{,T}$=6.00, the overall effect 0.90). Smart rural economy, water saving technologies and are chiqindili work out of the system, and the introduction to still also sufficient level underdeveloped. Innovative technologies introduction to make to foreign investment and scientific research be supported should.

6. Legal factors most low effect of having (W_L=0.12, S_L=5.67, the overall effect 0.68). Food safety on international standards and local legislation between yet also certain variations there are. HACCP, JESUS 22000 and GLOBAL.A.P. certification on rural household enterprises of the capacity increase should.

Conclusion and suggestions

The Republic of Uzbekistan in the conditions of food safety to ensure and environmental problems solve to on out go and **PESTEL analysis of the results of** that analysis these problems the solution in the environmental, economic , and political factors leading role he

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plays. **The analysis of the results according to environmental factors (9.33 points) and economic factors (8.67 points) food safety is the most great effect shows.** Soil degradation, water resources depletion and climate change in the country's rural economy on the potential negative effect it has. This with along, work production costs increase, the rural economy of investment, the size of enough is not and environmentally clean products market development such as economic factors also food security on the direct impact it has.

Political and legal factors of the average level in the effect of showing ,despite the existing legislative base and state of the program is practical natijadorligi on some problems there. The country's food security is to ensure on a number of strategies to work outilga ,although international standards fit on the basis of **HACCP, JESUS 22000 and GLOBAL.A.P. of the system with full implementation to be addressed required are.** Social factors, in particular, the population of the environmental clean food products, the demand increased and increased ,although consumer culture and awareness level of sufficient level is not.

Technological factors price, **smart rural economic systems, water saving technologies and are chiqindili work out of the process enough development.** This area of innovative technologies introduction to through food security, strengthening the possibility is there.

The Republic of Uzbekistan in the conditions of food safety to ensure and environmental problems solve to for complex and systemic approach is required to. PESTEL analysis of the results of that analysis, environmental, economic , and political factors in these problems the solution in an important role plays. For this reason, the following suggestions previously push to the purpose it is:

First of all, environmental stability, ensure to modern resource - saving technologies of wide introduction to it is necessary. Water deficiency conditions in drip irrigation and other advanced irrigation methods ,the development of rural agriculture chemical fertilizers and pesticides consumption reduction, organic agriculture in economic development priority of the tasks one be should. That ,in addition to rural household waste, re - work of the system, the path put in and environmental clean packaging material to use to encourage important.

Secondly, the state by agriculture agriculture environmental sustainability increase to stimulating measuresto current thesystem further accelerate should. Do this to environmentally clean products production production with the involved farmers are subsidized and tax benefits to give, environmentally safe agriculture economic methods of application to enterprises

financial support mechanisms for expansion should be. Also, food safety on the monitoring system improvement and modern laboratory the further expansion through quality control , strengthen the should.

Third, modern innovative technologies of wide implementation to through food security strengthening is achieved. In particular,the smart rural economic system development, music method using high yield has environmentally clean products cultivation and genetic modifikatsiyalangan products safety scientific aspects of deep study is required to. This with along the food production production and distribution of digital technologies and artificial intelligence on the basis of automated monitoring systems implementation to through efficiency increase should.

Fourth, international cooperation, development and the global experience to use it is necessary. Uzbekistan food security in ensuring FAO, WHO and other international organizations with the cooperation expansion environmental standards to fit , which comes certification systems development and international environmental standard compliant products exports development on certain programs worked out in accordance with the purpose of further expansion. International experience based on the case in a stable food supply to achieve to innovative technologies and environmental aspects of clean work out methods for a wide range of current to required are.

Fifth, food security , ensuring aimed at the legal framework for further strengthening should be. In uzbekistan, food safety and environmental standards combination for HACCP, JESUS 22000 and GLOBAL.A.P. like the international certification system of the national legislation into the integration makefurther improvement is necessary. Also, environmentally clean products to promote and consumers reliable information to deliver for environmental products certificate to the system to simplify and publicity to ensure required are.

In conclusion, ensure to environmentally sustainable rural economic system, the formation of public policy improvement, international standards implementation to and innovative technologies to introduce to it is necessary. This with along food production ,production, distribution and consumption in the process of effective management of the system of the path put in and the population of the environmental awareness increase through sustainable developmentis important at striped effortlessly.

References:

1. FAO/WHO. (2020). Risk assessment methodologies for food safety: A comprehensive guide.
2. Of the united nations. (2023). Global Food Security Report.
3. FAO. (2022). The State of Food Security and Nutrition in the World.
4. OECD-FAO. (2018-2027). Agricultural Outlook.
5. Paris agreement. (2015). UNFCCC Climate Change Agreement.
6. Below is the document from the obtained information is based , in the case that were used in the literature listed in'yxati required are in the format it was made:
7. Baikadamova, A., Yevlampiyeva, Y., Orynbekov, D., & not other. (2024). The effectiveness of implementing the HACCP system to ensure the quality of food products in the region with ecological problem. Frontiers in Sustainable Food Systems, 8, 1441479.
8. Donayevich, K. G. (2024). Food safety in ensuring environmentally clean products produce both o'rni. Different soil-climatic conditions in organic agriculture receives the ambassador'jalik the products produced in innovative technologies, the use of actual on the topic of international scientific-practical conference materials, 121-124.
9. Do not ji, S., Wang, F., Li, K., & not other. (2021). Environment and food safety: A novella is integrativ review. Environmental Science and Pollution Research, 28(21), 16069-16087.
10. Lopez-Galvez, F., Gómez, P. A., Artés, F., Artés-Hernández, F., & Aguayo, E. (2021). Interactions between microbial food safety and environmental sustainability in the fresh product supply may be underweight. Foods, 10(1655), 1-24.
11. Nadiradze, K., & Phirosmanashvili, N. (2014). Food safety and environmental issue. Scientific Journal of Agriculture, 2(1), 45-60.
12. 6. Sheripbaeva, U. (2024). Global climate o'zgarib that in the context of food security ensuring and sustainable development directions. Scientific-Practical Symposium on the Rolan of the plan Genetic Resource in Global Climate Change and Food Security, 495-497.
13. Varzakas, T., & Smaoui, S. (2024). Global food security and sustainability issues: The road to 2030 from nutrition and sustainable health diet to food systems change. Foods, 13(306), 1-29.