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Neutrosophic Framework for Analyzing Factors of innovation in the Development of Uzbekistan: features and modern tendencies

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Abstract

This paper analyzes the features, positions, and results of the innovative development of Uzbekistan, and the goals and tasks of the country in this process until 2030. The authors consider measures to create conditions for the development of innovative activity. Considering the ongoing reforms in the country in the system of interaction between environmental and economic aspects of development, the paper analyzes the priority areas of eco-innovative development of the country, including measures that contribute to the transition to sustainable development based on a "green" economy. Implementation of the principles of the "green" economy associated with economic modernization, updated of technological funds, avoidance of export-raw material dependence, eco-innovative development, which ensure the sustainable development of the country are considered. This paper introduced the neutrosophic environment for analysis of factors of innovation. This paper used the neutrosophic sets to overcome the uncertain information. Then the concept of multi-criteria decision-making is used to deal with various factors. This study used the neutrosophic AHP method to identify and analyze factors of innovations. The neutrosophic AHP method is used to compute the weights of criteria, then rank it. The purpose of the study is to identify, analyze and resolve the problems of the environmental and economic aspect of the innovative development of the Republic of Uzbekistan using neutrosophic sets. The theoretical and methodological basis of the study was the works of foreign and domestic scientists devoted to the problems of innovative development, including works devoted to the study of eco-innovative development.

Keywords: innovation; eco-innovative development; climate change; research and development; ARDL model; Neutrosophic Set; AHP; MCDM

1. Introduction

In The Strategy of Actions on Five Priority Areas of Development of the Republic of Uzbekistan for 2017-2021 special attention is paid to stimulating research and innovation activities, creating effective mechanisms for introducing scientific and innovative achievements into practice, creating scientific and experimental specialized laboratories, high technology centers, technology parks at higher educational institutions and research institutes.

In order to determine priority areas for reforms aimed at transforming sectors of the economy, accelerated development of entrepreneurship and innovative economy, Development Strategy of New Uzbekistan for the period of 2022-2026 was approved [1].

This Development Strategy provides for:

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- widespread introduction of innovations in the economy, development of cooperative ties between industrial enterprises and scientific institutions;
- improving the position of The Republic of Uzbekistan in Global Innovation Index and inclusion in top 50 countries of the ranking until 2030;
- by 2026, increase the energy efficiency of the economy by 20 percent and reduce emissions of harmful gases into the atmosphere by 20 percent through the active introduction of "Green economy" technologies.

The purpose of the study is to identify, analyze and resolve the problems of the environmental and economic aspect of the innovative development of The Republic of Uzbekistan. In the 1970s, the AHP was developed as a technique for analysing systems. This technique shines when used in the study of complicated systems, particularly those that defy easy descriptions. Research on the construction of a numerical framework for analysis factors of innovations of firm marketing is still in its infancy among domestic corporations. When analysing complex mathematical frameworks, AHP is the method of choice. For their medical research, Felber et al. created a survey that participants administered themselves based on the analytic hierarchy process (AHP). We used a paper survey with an item reply mechanism to gather data via focus groups. An eigenvector method was used to analyze the results for patients[2], [3].

When applied to practical decision-making, Neutrosophic Sets (NS) provide a more comprehensive framework than crisp, fuzzy, and intuitive sets[4], [5]. Since it is not always possible to put an exact numerical value on a person's thoughts (they may be fuzzy, unfinished, incompatible, or imprecise), it is preferable for individuals to shift their preferences among the truth, falsehood, and unpredictability functions in order to arrive at more concrete conclusions. Multi-Criteria Decision Making (MCDM) assignment methods for dependability have hitherto ignored such data[6], [7].

The goal from this paper, ranking the factors of innovation in development in Uzbekistan. These factors are ranked by using MCDM method named AHP. The AHP is a MCDM method used to build the pairwise comparison matrix between factors. The concept of neutrosophic set is used to deal with uncertain data. The objectives of the study are: identifying, analyzing and resolving the problems of the environmental and economic aspect of the innovative development of The Republic of Uzbekistan, analyzing the structure of Gross domestic spending on R&D by types and sources of financing, the share of exports of high-tech products, the experience of eco-innovative development.

2. Methodology

The article used: general scientific methods for studying economic systems, including analysis and synthesis; methods of economic and mathematical modeling, especially, Autoregressive Distributed Lag (ARDL) made by using secondary numerical data of The State Committee of Republic of Uzbekistan on statistics, methods of detailing and generalization, economic and statistical methods; methodology for the analysis of innovation activity.

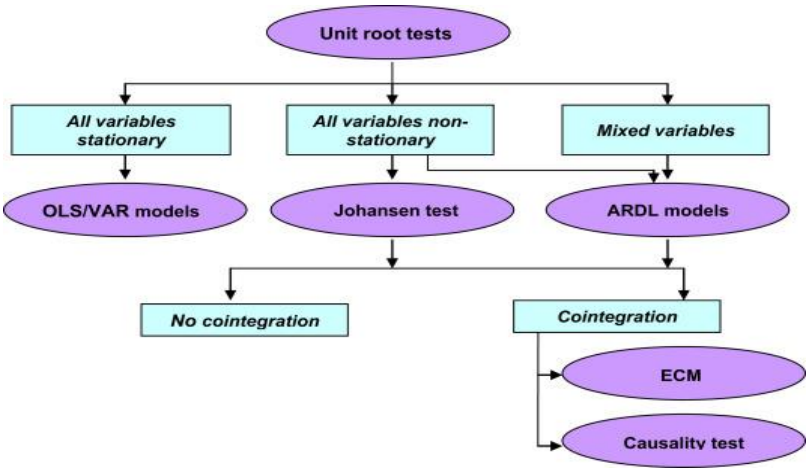

Figure 1: The procedure for developing an econometric ARDL model by the authors.

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2.1 Neutrosophic AHP Method

This section introduced equations of interval valued neutrosophic sets and neutrosophic AHP method[8]–[11].

There are two IVNNs as $X = [T_x^L, T_x^U], [I_x^L, I_x^U], [F_x^L, F_x^U]$ and $Y = \left[T_y^L, T_y^U\right], \left[I_y^L, I_y^U\right], \left[F_y^L, F_y^U\right]$

$$X \oplus Y = \begin{pmatrix} \left[T_x^L + T_y^L - T_x^L T_y^L, T_x^U + T_y^U - T_x^U T_y^U\right], \\ \left[I_x^L I_y^L, I_x^U I_y^U\right], \\ \left[F_x^L F_y^L, F_x^U F_y^U\right] \end{pmatrix} \quad (1)$$

$$X \ominus Y = \begin{pmatrix} \left[T_x^L - F_y^U, T_x^U - F_y^L\right], \\ \begin{bmatrix} \max\left(I_x^L, I_y^L\right), \\ \max I_x^U, I_y^U \end{bmatrix}, \\ \left[\left[F_x^L - T_y^U, F_x^U - T_y^L\right]\right] \end{pmatrix} \quad (2)$$

$$X \otimes Y = \begin{pmatrix} \left[T_x^L T_y^L, T_x^U T_y^U\right], \\ \left[I_x^L + I_y^L - I_x^L I_y^L, I_x^U + I_y^U - I_x^U I_y^U\right], \\ \left[F_x^L + F_y^L - F_x^L F_y^L, F_x^U + F_y^U - F_x^U F_y^U\right] \end{pmatrix} \quad (3)$$

$$X^\lambda = \begin{pmatrix} \left[(T_x^L)^\lambda, (T_x^U)^\lambda\right], \\ \left[(I_x^L)^\lambda, (I_x^U)^\lambda\right], \\ \left[1 - (1 - F_x^L)^\lambda, 1 - (1 - F_x^U)^\lambda\right] \end{pmatrix} \quad (4)$$

$$\lambda X = \begin{pmatrix} \left[1 - (1 - T_x^L)^\lambda, 1 - (1 - T_x^U)^\lambda\right], \\ \left[(I_x^L)^\lambda, (I_x^U)^\lambda\right], \\ \left[(F_x^L)^\lambda, (F_x^U)^\lambda\right] \end{pmatrix} \quad (5)$$

Step 1. Build the hierarchy problem

The suggested allocation issue depends on the organized hierarchy presented by Zahedi and Ashrafi for dividing up software dependability between different modules in a component system. There are four tiers in this structure that relay user feedback to programmers. The company's issue definition is at the first level. In the second tier, features are specified according to what end users need and anticipate from the program. Software developers create advanced programs to carry out certain tasks. The last tier is made up of separate modules, which are the individual pieces of code that are used to create larger programs. Computer code is created by scientists. Figure. 2. Shows the steps of the proposed method.

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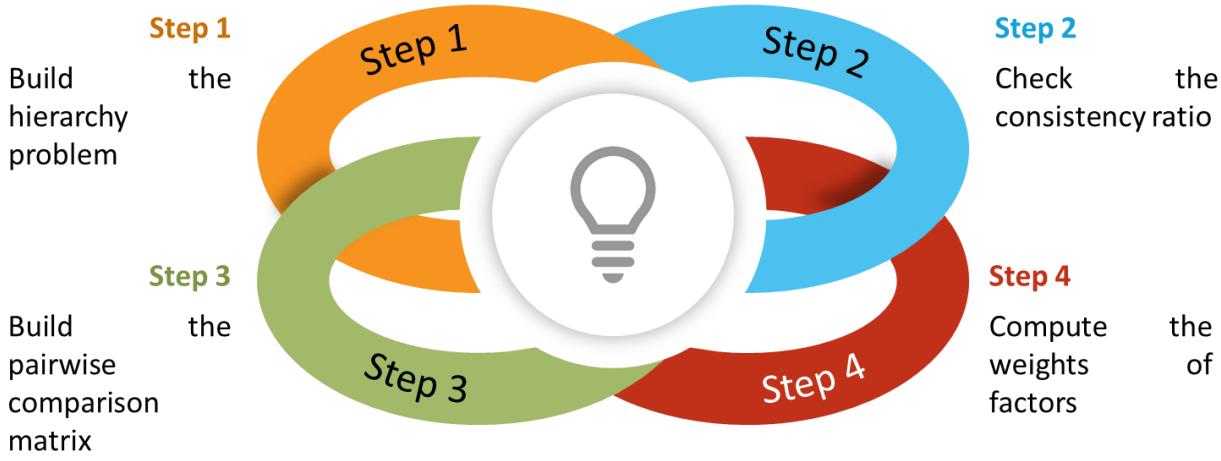

Figure. 2: The phases of the suggested method.

Step 2. Build the pairwise comparison matrix

After breaking down the issue into its constituent parts, the neutrosophic pair-wise comparison arrays are created so that program administrators may rank the relative value of the method's many components. The neutrosophic setting and neutrosophic set are used to create these comparative matrices.

Step 3. Check the consistency ratio

It is essential to check the consistency of the assessment matrices provided by the various administrators at every tier of the structure when computing the relative weight of every component. Using the Consistency Index (CI) and Consistency Ratio (CR) provided by the AHP approach, we examine the reliability of the neutrosophic assessment matrix. The matrix is consistent if and only if the consistency ratio (CR) is smaller than 0.1. Once the neutrosophic numbers are converted to crisp values, the consistency of the comparison assessments matrix may be determined.

$$CR = \frac{CI}{RI} \quad (6)$$

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (7)$$

Step 4. Compute the weights of factors

The constant neutrosophic pair-wise contrast matrix may be used to determine weights for operations, programs, and components. Using rating and accuracy level numbers, the array is first transformed into a predictable form.

$$W_j = \frac{w_j}{\Sigma_{i=1}^{j} w_j} \quad (8)$$

3. Results

As part of the implementation of the innovative development model, the Law “On Science and Scientific Activities” and the Law “On Innovation Activities” of The Republic of Uzbekistan were adopted. Ministry of Innovative Development is an authorized state body in the field of science, scientific and innovative activities [12]. In the structure of the Center for Advanced Technologies under the Ministry of Innovative Development of the Republic of Uzbekistan, an Innovative Startup Accelerator and Startup Incubator for high-tech small companies have been created, with the provision of existing infrastructure, premises, laboratories and equipment on preferential terms [13].
The most important indicators of the country's R&D development, as is known, are: the number of organizations that carry out research and development; R&D cost structure by types and sources of funding; share of exports of high-tech products (Table 1).

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Table 1: The main indicators of R&D and development of scientific researches of the Republic of Uzbekistan for 2017-2020

Indicators	2017	2018	2019	2020
1. Number of organizations performing research and development, by sector of activity (units), total	389	668	304	254
including: - government sector;	181	289	118	108
- business sector;	121	220	121	79
- higher education sector	78	146	64	65
- private non-profit sector.	9	13	1	2
2. The structure of current costs for research and development (in %)	100,0	100,0	100,0	100,0
- for scientific and technical developments;	27,3	30,8	28,4	34,8
- for applied research;	45,8	41,4	43,5	47,2
- for fundamental research.	26,9	27,8	28,1	18,0
3. R&D expenditures by funding source (million soums), total	464 994,5	16 493,3	89 577,7	24 708,5
- total budget funds	260736,6	284409,1	390 88,4	524252,6
- means of off-budget funds;	12747,7	14871,8	25 076,7	24 660,0
- own funds;	136744,1	18685,6	151485,5	199679,4
- customer funds	52 103,8	28 575,7	20 085,1	75 880,5
- means of foreign sources.	2 662,3	1 567,8	2 142,0	236,0
4. Share of exports of high-tech products, in % of total exports.	1,7	1,7	1,7	2,0

Source: Compiled by the authors based on data from the statistical collection "Science and innovation activity in Uzbekistan". The State Committee of Republic of Uzbekistan on statistics. Tashkent. 2021.

To improve the ecosystem and sustainable life in the saline lands of the dried bottom of the Aral Sea and organize work on the development and implementation of innovations, with the scientific and technical support of Islamic Development Bank and International Center for Biofarming, International Innovation Center of the Aral Sea Region under the President Administration of the Republic of Uzbekistan was established [14].

In 2020, Uzbekistan ranked 93rd, out of 131 in Global Innovation Index (GII) ranking (in 2015, Uzbekistan ranked 122nd, out of 140). In 2021, the republic improved its position and took 86th place in the GII ranking, out of 132 countries (4th place among 10 countries in Central and South Asia).

In the structure of current R&D costs in the period from 2017 to 2020, the costs associated with scientific and technical development and applied research increased in contrast to the costs of basic research, where there was a decrease from 26.9% in 2017 to 18.0% in 2020 year.

If we consider the costs of R&D by sources of financing, then the decrease was noted only in terms of financing from foreign sources (from 2662.3 million to 236 million Soums).

The development of high-tech exports, whose share in world trade is constantly growing, is regarded as one of the important sources of economic growth. However, the share of exports of high-tech products in the total exports of the republic, despite the growth in 2020, is still insignificant (1.7 - 2.0%).

In the structure of the manufacturing industry in 2018, a significant share fell on medium-low-tech industries - 31.4% (25.7% in January - August 2017), and on medium-tech industries - 28.2% (20.4%) [15].

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In 2021, the share of high-tech industries was already 2.7% (2.0 % in January-December 2020), medium-tech - 20.1% (22.4%), medium-low-tech - 39.4% (39.9%) and low-tech - 37.7% (35.7%) [16].

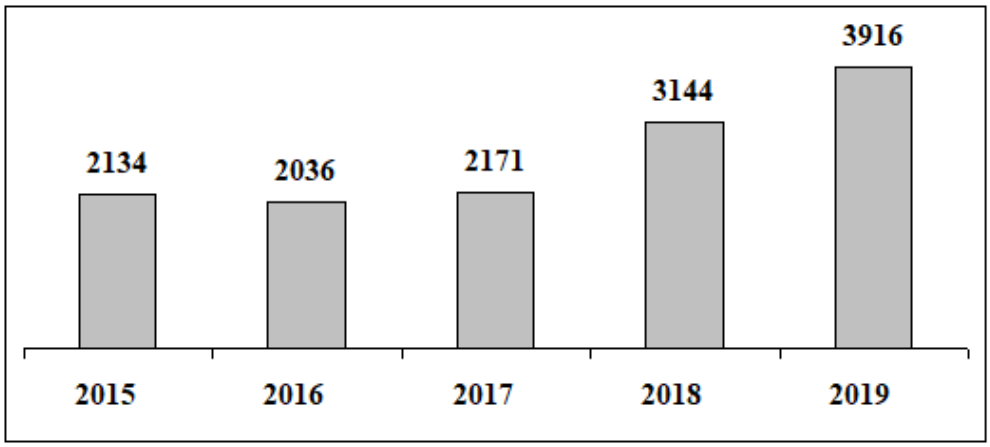

Figure 3: The number of enterprises and organizations of the Republic of Uzbekistan that carried out the production of innovative goods, works and services in 2015-2019 (unit). *Source: Compiled by the authors based on the data of the State Committee of the Republic of Uzbekistan on statistics for 2015-2019.*

Positive dynamics was noted in terms of growth in the number of enterprises and organizations of the Republic of Uzbekistan that produced innovative goods, works and services (Figure. 1). From 2015 to 2019, the number of enterprises and organizations engaged in the production of innovative goods, works and services has been steadily growing and amounted to 3916 in 2019.

The number of implemented innovations, with the exception of organizational innovations, had a steady growth trend in 2015-2019 (Table 2).

Table 2: Number of implemented innovations in 2015-2019 in the Republic of Uzbekistan (unit)

	)15	)16	)17	)18	19
Total implemented innovations	1737	1799	1946	2482	4427
Such as:					
Product innovations	1122	1118	1372	1578	3543
Prosses innovations	615	681	574	904	884
Marketing innovations	36	51	62	42	128
Organization innovations	46	39	38	34	13

Source: Compiled by the authors based on the data of the State Committee of the Republic of Uzbekistan on statistics for 2013-2019.

The number of implemented technological innovations and the number of organizations that introduced innovations in 2015-2019 increased from 1737 to 4427 units, and from 894 to 1514 units, accordingly (Figure.3).

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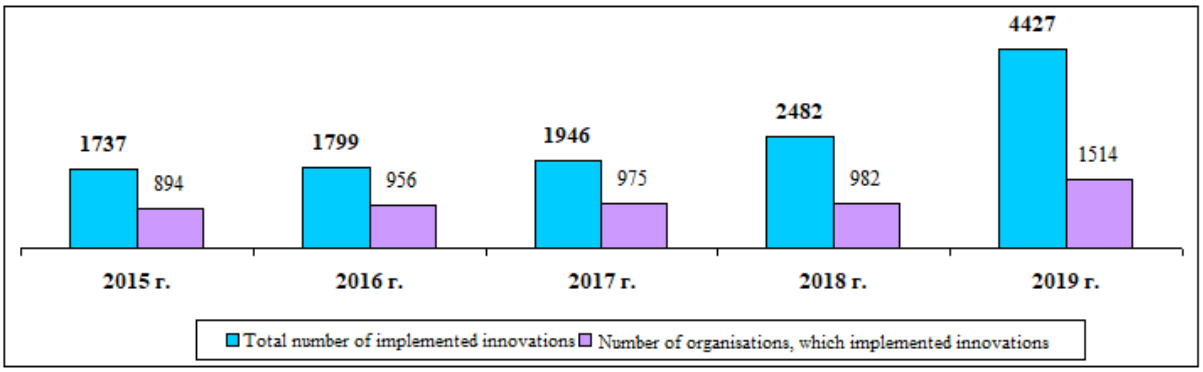

Figure 4: The number of implemented technological innovations by organizations of the Republic of Uzbekistan in 2015-2019 (units). *Source: Compiled by the authors based on the data of the State Committee of the Republic of Uzbekistan on statistics for 2013-2019.*

At the same time, the factors that hinder innovation activity remain: lack of financial resources; low demand for new goods, works, services; high cost of innovation; lack of qualified personnel, information about new technologies and markets; underdevelopment of the innovation infrastructure (Table 3).

Table 3: Factors hindering innovation activity in the Republic of Uzbekistan in 2015-2019 (as a percentage of the total number of respondents who answered this question)

Factors	2015	2016	2017	2018	2019
Lack of funds	52	28,3	46,1	25	23,1
Low demand for new goods, works, services	16,7	6,4	5,8	3,3	8
High cost of innovation	19,9	7,2	18,4	10,5	12,9
High economic risk	19,3	8,5	13,7	7,6	9,3
Lack of qualified personnel	18,6	9,8	24,9	13,4	11
Lack of information about new technologies	14,7	8,4	16,4	8,5	7,2
Lack of market information	12,7	4,2	14,7	8,3	6,5
Underdeveloped innovation infrastructure	15	8,8	15	8,3	7,2
o need for new innovations thanks to previous	32	18,4	28	15	14,7

Source: Compiled by the authors based on the data of the State Committee of the Republic of Uzbekistan on statistics for 2013-2019.

Environmental crises in recent years have also influenced innovation policy [17]. In 2012, Uzbekistan's cumulative greenhouse gas (GHG) emissions accounted for 0.33 percent of global emissions [18]. Uzbekistan's per capita emissions are 5.95 tons of CO2-eq. per capita. This is well below the per capita GHG emissions in neighboring Kazakhstan (21.8 tons), the OECD average (12.9 tons) and the global average (7.5 tons) [19].
Ecological innovation is considered by European Eco-Innovation Platform as any form of innovation aimed at achieving the goals of sustainable development, taking into account the reduction of environmental impact, increasing environmental sustainability, and achieving efficient use of natural resources [20]. As part of EU Environmental Technologies Action Plan (ETAP), a set of measures is being implemented to promote environmental innovation.

From another point of view, within the framework of the theory of eco-innovation, a three-stage typology of the supply chain is proposed, built on the basis of an analysis of existing structures of sustainability, within which innovation was recognized as a key factor in sustainability [21].
Eco-innovation (eco-innovation) refers to the introduction of a new or significantly improved product, process, organizational change or marketing solution that reduces the consumption of natural resources (raw materials, energy, water and land) and the amount of emissions of harmful substances throughout the life cycle [22].

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Innovation policy, implemented through a set of public policy instruments to directly or indirectly support innovation, is central to the green transition [23].
Gurieva M.A. notes that the introduction and development of environmental innovations are motivated by environmental and economic reasons. Eco-innovations, in her opinion, are aimed at solving problems of reducing resource consumption, monitoring the safety of the environment, reducing costs to eliminate the bad impact of production activities and the production of eco-products [24].
Ahmad, M. Et al., 2023 underscored the importance of considering the interplay between ICT, human capital, globalization, and environmental sustainability in OECD countries. The findings provide valuable insights for policymakers and stakeholders in developing strategies and policies that prioritize environmental protection while fostering economic development. By promoting sustainable practices, investing in renewable energy sources, and harnessing the potential of ICT, OECD countries can work towards achieving a more sustainable and environmentally friendly future [25].
E.S.Botenovskaya carried out a comparative analysis of environmentally oriented innovative development, analyzed the eco-innovation indices of the European Union and the Eco-innovation index of the Asia-Europe Forum (ASEM) [26].

According to M.P. Imekova, environmental innovations are one of the main instruments of sustainable development and without relying on such innovations it is impossible to increase the competitiveness of the country, solve the problems of economic and social development [27].
So, 2020 was one of the three warmest years on record. The global mean temperature was 14.9°C, 1.2°C above pre-industrial levels (1850-1900) [28].
Climate change has a significant impact on the natural ecosystems of the countries of Central Asia. Central Asian states are experiencing the impact of climate change in the form of rising temperatures, melting glaciers, and transformation of river flow. The average annual temperature in Kazakhstan increased by an average of 0.31°C for every 10 years [29]. In recent years, the greatest warming occurred in winter - by an average of 0.35ºC/10 years, and the lowest rate of temperature increase was observed in summer, in the range from 0.12 to 0.27ºC/10 years [30].

In Kyrgyzstan, for the entire period of observations, the average annual temperature increased throughout the country at a rate of 0.0104ºC/year, then for the period of 1960–2010, the rate increased significantly and amounted to 0.0248ºC/year [31].
In 2001-2010 turned out to be the warmest decade in the history of meteorological observations in Tajikistan. In the zone up to 1000 meters above sea level, the average temperature of the decade exceeded, normally by 1º, at altitudes from 1000 meters to 2500 meters above sea level equals 0.8º [32].
The analysis of meteorological data in Turkmenistan also indicates a steady increase 1.4°C in temperature since 1950 [33].
In Uzbekistan, the highest rates of warming are observed in Karakalpakstan (0.43°C for 10 years) and Tashkent region (0.36°C for 10 years) [34]. The risks of the impact of climate change in Uzbekistan are associated with: an increase in the average temperature over the next 50 years within 2-3°C; a decrease in river flow by 2-5% in the basin of the river (Syr Darya and Amu Darya 10-15% in the river basin); reduction in crop yields from 20% to 50% in the absence of adaptation measures [35].
Climate change is a cross-cutting challenge affecting the 2030 Agenda for Sustainable Development. In general, the countries of Central Asia are vulnerable to climate change and face rising temperatures, changing precipitation and water scarcity (Sustainable Development Goals - SDGs 13, 2 and 6) [36], [37].
The authors analyzed 19-year data from the State Committee of the Republic of Uzbekistan on statistics for 2000-2018 – the volume of industrial output in the country and the cost of R&D development. And using the ARDL model, the relationship between them was determined.
So, hypothesis – H_0: There is a relationship between volume of industrial products and volume of expenditures for Innovation in Uzbekistan.
H_1: There is no relationship between volume of industrial products and volume of expenditures for Innovation in Uzbekistan.
The ARDL model was chosen for the multi-factor nonstationary time series.

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Table 4 (a): Results of ***Fisher*** and ***t*** test statistics and other essential indicators

ogarithmic Volume of industrial products of Uzbekistan as fitted value	**oeffic ents**	**tand ard rrors**	**t**	**>|t|**	**[95% Conf. Interval]**	
irst lag of Logarithmic Volume of industrial products of Uzbekistan	0.9668	0.0175	56.02	0.000	0.9293	1.0042
Logarithmic Volume of expenditures for Innovation in Uzbekistan	0.0184	0.0399	0.46	0.652	-0.0667	0.1035
Constant	0.6331	0.1660	3.81	0.002	0.2792	0.9870

Source: Compiled by the authors at STATA based on the data of the State Committee of the Republic of Uzbekistan on statistics

Table 4 (b): Number of observations

Number of observations	**18**
F(2, 15)	1725.10
Prob > F	0.0000
R-squared	0.9957
Adjusted R-squared	0.9951
Root MSE	0.0893

F test indicates the originality of the model. t test also illustrates that the parameters are statistically significant. So, the estimated equation will be of the form:

$$\Delta Lny_t = \delta Lny_{t-1} + \lambda\, Ln\, x + u_t$$

Accordingly, the following equation determined:

$$\Delta LnIndustry_t = 0.96 LnIndustry_{t-1} + 0.018\, Ln\, Innovation_t + 0.63$$

here: $\Delta LnIndustry_t$ *– Logarithmic Volume of industrial products of Uzbekistan*
Δ Ln Industry(t-1) – first lag of Logarithmic Volume of industrial products of Uzbekistan
λ Ln Innovation$_t$ *– Logarithmic Volume of expenditures for Innovation in Uzbekistan*

Employed a logarithmic transformation, which makes the equation linear in its parameters. As a result, when the R&D cost increases 1 %, volume of industrial products of the country increases 1.8 %, in the condition of other indicators unchanged. As well as the first lag of the volume of industrial products also (96%) affects to the current value of it.

Results of neutrosophic AHP method

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This part introduced the results of the neutrosophic of AHP method. The experts are gathered the factors from the literature. All factors are available in Table 3. Then let experts evaluate the criteria by using interval valued neutrosophic numbers as shown in Table 5.

Table 5: The values of pairwise comparison matrix

	FIDU1	FIDU2	FIDU3	FIDU4	FIDU5	FIDU6	FIDU7	FIDU8	FIDU9
IDU1		236 9	17 8	541 5	86 6	179 6	123 3	4379 5	3 6
IDU2	4.22119	1	0.369	0.369	0.123	0.96	0.2945	0.7667	0.50145
IDU3	.210963	2.710027	1	0.4948	0.963	0.17995	0.366	0.369	0.667
IDU4	.585874	2.710027	4.642008	1	0.1233	0.456	0.246	0.2369	0.5519
IDU5	.154734	8.130081	1.038422	8.110348	1	0.51295	0.369	0.17995	0.3369
IDU6	.198903	1.041667	6.175636	2.192982	2.744309	1	0.1343	0.236	0.6016
IDU7	8.1103	5.138002	2.73224	5.420054	2.710027	7.499107	1	0.6016	0.1236
IDU8	.893068	1.304291	2.710027	4.22119	6.175636	4.237288	2.628033	1	0.6016
IDU9	.777778	2.763337	1.49925	2.687363	2.96824	2.628033	8.090615	2.628033	1

Then normalize the pair comparison matrix as shown in Table 6. Then compute the weights of factors using Eq. (8). Then compute the CR value. The CR is less than 10%. The weights of factors are shown in Figure. 5.

Table 6: The normalization of pairwise comparison matrix

	FIDU1	FIDU2	FIDU3	FIDU4	FIDU5	FIDU6	FIDU7	FIDU8	FIDU9
FIDU1	0.026916	0.009463	0.008749	0.021628	0.049	0.010174	0.009304	0.067835	0.075885
FIDU2	0.113617	0.039945	0.018138	0.014738	0.00696	0.054382	0.022223	0.118755	0.105701
FIDU3	0.167173	0.108252	0.049153	0.019763	0.054488	0.010194	0.027619	0.057155	0.140597
FIDU4	0.123433	0.108252	0.228169	0.039941	0.006977	0.025831	0.018564	0.036694	0.116335
FIDU5	0.031081	0.324757	0.051042	0.323931	0.056582	0.029058	0.027845	0.027873	0.071015
FIDU6	0.166849	0.04161	0.303552	0.087589	0.155278	0.056648	0.010135	0.036554	0.126811
FIDU7	0.218296	0.205238	0.134298	0.21648	0.153338	0.424808	0.075462	0.093183	0.026054
FIDU8	0.077869	0.0521	0.133206	0.168596	0.349429	0.240033	0.198316	0.154891	0.126811
FIDU9	0.074766	0.110382	0.073693	0.107335	0.167949	0.148872	0.610532	0.40706	0.21079

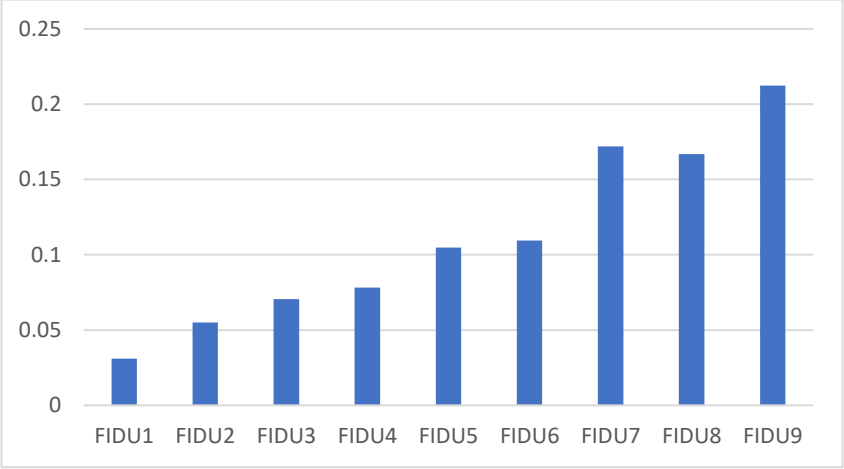

Figure. 5: The rank of factors innovation in the process of development.

4. Conclusion

A sectoral analysis of the number of organizations performing R&D allows us to note the preservation of the dominant role of public sector over the entire analyzed period. However, number of enterprises and organizations that produced innovative goods, works, services on their own by type of economic activity increased. There is a steady growth in the number of enterprises and organizations producing innovative goods, works, services on their

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own. During the analyzed period, technological innovations tended to grow from year to year, the sharp quantitative growth of which falls on 2017-2019. As the quantitative indicator of the implemented technological innovations grows, we can also note the steady growth of the organizations involved in the implementation of innovations. In turn, the analysis of this indicator by sectors of the economy indicates the involvement of structure-forming industries in this activity. Thus, for the analyzed period, the largest share of technological innovations introduced belongs to the manufacturing industry, followed by low-tech industry, medium-low technology, etc. A lower indicator is observed in the implementation of organizational innovations by organizations and industries in the national economy. Despite the quantitative growth of marketing innovations in general, instability is observed in the quantitative indicator of organizations that have implemented marketing innovations. A serious factor hindering the innovative development of the economy is the low demand for innovative goods, works, services, lack of information about sales markets, and high economic risk. Under these conditions, the need to take into account environmental risks, including climate change, as one of the key long-term factors of eco-innovation security of the Republic of Uzbekistan puts forward the problem of adaptation to global climate change among the country's priorities. The most important factor in the implementation of this task is the formation and implementation of a unified state policy of the Republic of Uzbekistan on issues related to climate change and its consequences, including the management of greenhouse gas emissions, reducing emissions in economic sectors, ensuring the sustainability of socio-economic development in the face of climate change. The development of a legal framework and strategic documents for eco-innovative development, taking into account the comprehensive consideration of the problems of climate change and disaster risk reduction, is a priority for development. All this necessitates the study of the features of environmental innovation development, the innovative activities of organizations that carry out environmental innovations, and the impact of environmental innovations on the socio-economic development of the country. This study used the neutrosophic model to deal with uncertain data in evaluation factors of innovation in the process of development. This study aims to rank and identify factors of innovation, so the MCDM methodology to deal with problem. The AHP is used to compute the weights of these factors. The neutrosophic set is integrated with the AHP method to compute weights of criteria.

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