



Article

Prospective Directions for Forecasting The Sustainable Development of The Social Sphere in The Khorezm Region

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Abstract: This article discusses the features, current opportunities, and prospects of forecasting the sustainable development of the social sphere in the Khorezm region. Also, conclusions are given on the study of the prospects for forecasting the sustainable development of the social sphere in the Khorezm region. The article provides an in-depth analysis of innovative management mechanisms for advancing the social sector, evaluation criteria for measuring the efficiency of regional development programs, and the potential applications of artificial intelligence and geoinformation technologies. The research findings are supplemented with practical recommendations aimed at promoting sustainable social progress, ensuring the rational use of resources, and enhancing the well-being of the population in the Khorezm region.

Keywords: Khorezm region, social sphere, forecasting, prospects, region, service.

1. Introduction

The guarantee of the sustainable development of the social sector in the Khorezm region is a crucial precondition for the enhancement of the entire socio-economic growth of the territory, as well as the increase in the living standards and the overall level of human capital. The skill to handle social processes effectively has become a strategic imperative in an era where there is rapid globalization and increasing interdependence between social-economic processes. It will demand strict analysis of demographic patterns, proper projections of work processes and level of household income, and constant modernization of educational and medical facilities. The demographic data of Khorezm, such as the stable growth of the labor force, differences in population distribution between the city and the country, and uneven development of infrastructure, are the trends of the long-term evolution of the region. Also, the increasing demands of society to have available social services of high quality and reasonable accessibility point to the necessity of the coherence of the regional social policy as well as its evidence-based and scientifically supported nature. This will be critical in terms of facilitating balanced growth in the territories, enhancing social stability, and inclusive growth in the region. The modern research states that the development of the area is strictly connected with the state and the efficiency of the social sector. This is mainly attributed to the fact that contemporary social systems are becoming more and more dependent on the technologies of the social design, predictive models, and prospective methods of analysis. These tools are conclusive in determining new social problems, organizing the institutional processes, and building viable models of implementation that will address the problems of the system.

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Literature Analysis

The combination of methodological flexibility and analytical precision inherent in such technologies forms a critical foundation for designing long-term strategies for social development. Consequently, they contribute to shaping the region's long-term prospects, enhancing its functional capacity, and ensuring sustained progress[1]. These analytical approaches also provide a comprehensive reflection of ongoing structural transformations within the social sphere. Existing studies emphasize that shifts within the social domain significantly influence national development outcomes and articulate how social reforms contribute to broader socio-economic progress in Uzbekistan [2]. Based on these findings, ensuring the provision of accessible and high-quality social services to the population becomes a key policy priority. Recent investigations further indicate that future-oriented forecasting of social service delivery, particularly at the district level, plays an essential role in anticipating population needs, including housing demand and the provision of essential welfare services [3]. The central purpose of such research lies in advancing both the theoretical and practical dimensions of social forecasting. Moreover, these studies aim to identify persistent methodological shortcomings that may hinder the development of social forecasting as an academic field and practical policy tool. By analyzing these limitations, researchers propose targeted recommendations aimed at overcoming existing barriers and enhancing the methodological robustness, reliability, and applicability of social forecasting practices [4].

In recent years, the Khorezm region has undergone extensive reforms aimed at modernizing its social sector, improving the quality of public services, and expanding the participation of the private sector in these processes. A wide range of policy measures has been gradually introduced to strengthen social infrastructure, broaden the scope of available services, integrate market-based mechanisms, and enhance the overall standard of living for the population. The strategic goals outlined in the "Uzbekistan - 2030" development framework clearly illustrate the scale of tasks yet to be accomplished, particularly in ensuring equitable and high-quality social services for all segments of society and improving overall welfare indicators. As a result of ongoing transformations, the share of non-governmental providers in delivering social services has noticeably increased, thereby expanding opportunities to meet the diverse needs of the population. In the context of the internationalization of higher education and scientific research, fostering social development and societal sustainability requires institutional restructuring at a global scale. This includes a comprehensive examination of socio-historical systems and the multifaceted interactions that emerge among institutional structures operating within parallel or overlapping frameworks [5]. These changes are also reflected in regional statistical indicators. During the examined period, more than 3.93 million square meters of new housing were commissioned, while preschool institutions expanded by an additional 12.3 thousand places, general education schools by 45.9 thousand student places, and healthcare facilities were supplemented with 2.2 thousand hospital beds [6]. Current research in this domain focuses on deepening economic reforms and evaluating their outcomes. Specifically, the effectiveness of transformations in the fields of education, healthcare, and social services within the Khorezm region is critically assessed and empirically measured [7].

Several studies note that the social sphere represents a form of activity that is closely connected with comprehensive human development and the reproduction of the labor force within economic relations, encompassing working conditions, the living environment, and the effective use of leisure time [8]. For this reason, existing economic challenges should be examined not only from an economic perspective but also through the lens of social development. Another line of research investigates how the social sphere interacts with social relations. This approach conceptualizes the social sphere as a system of sectors, institutions, and organizational forms whose activities are directly aimed at meeting human needs and shaping people's standards and quality of life [9]. Additional studies emphasize that social networks consistently serve as objects of value assessment by both the state and society. At the international level, organizations and many countries recognize access to health services, education, and cultural heritage as fundamental

human rights [10]. In other scholarly works, the defining features of the social sphere are examined through the prism of management, with regional aspects of social development becoming an important topic in contemporary management debates due to their direct impact on the functioning of the social sector [11]. Another study explores various forms of inequality within the social sphere, arguing that regional disparities in living standards arise from uneven socio-economic development—primarily linked to the territorial distribution of productive forces, which holds strategic importance for any nation [12]. Consequently, achieving a balanced reduction of regional inequalities is viewed as a critical objective. Further research indicates that the structure of the social sphere encompasses different branches of the national economy as well as both public and private forms of governance. It is distinguished by its internal organizational composition rather than merely structural features [13]. Other scholars highlight that the social sphere plays a key role in enabling the full realization of human potential, which serves as an essential resource for modern economic renewal. In this context, various drivers of social change are identified [14]. Ultimately, socio-political factors are directed toward maintaining the stability of economic and political systems, enhancing population labor activity, developing human, economic, and social capital, and mitigating the adverse effects of factors that may negatively influence the socio-economic and political situation in the regions [15].

2. Materials and Methods

In carrying out this research work, existing methods widely used in scientific research methodology were used. In particular, in this study, the methods of observation, logical thinking, structural analysis, comparative analysis, scientific abstraction, grouping of information, analysis and synthesis, induction and deduction were effectively used in the study of promising areas for forecasting the sustainable development of the social sphere in the Khorezm region.

3. Results and Discussion

For this reason, the study places particular emphasis on generating forward-looking forecast values for the key indicators that reflect the dynamics of social service development in the Khorezm region for the period 2025–2030. To determine the prospective trajectory of the region's social sector, a comprehensive analysis of various statistical and econometric models was conducted. Among the examined alternatives, the model demonstrating the highest level of accuracy, statistical reliability, and predictive validity was identified and selected as the most suitable option for long-term forecasting:

$$TX_t = -250,94 + 1,90 * TX_{t-1} - 0,99TX_{t-2} - \varepsilon_{t-1} + 73,47 * t \quad (1)$$

Here: TX - represents the volume of social sector services in the Khorezm region, measured in billions of Uzbek soms.; while T - denotes the trend variable, starting from the year 2010.

The calculations conducted to assess the reliability of the selected model indicate that the computed z-statistics for each factor fully meet the established criteria. Specifically, the results fall either below -1.96 or above 1.96 , confirming the statistical significance of the considered factors. Furthermore, the corresponding probability values (p-values) used to evaluate the confidence level of these estimates were consistently below 0.05 in all cases. This demonstrates that the model parameters are significant with a confidence level exceeding 99% see Table 1.

Table 1. Calculations based on the selected multi-factor model were conducted to determine the projected volume of social service development in the Khorezm region for the period 2025–2030

Model 33: ARMAX, using observations 2010-2024 (T = 15)					
Dependent variable: TX					
Standard errors based on Hessian					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Z</i>	<i>p-value</i>	
const	-250.945	86.5810	-2.898	0.0038	***
phi_1	1.89829	0.0540016	35.15	<0.0001	***
phi_2	-0.988207	0.0147728	-66.89	<0.0001	***
theta_1	-1.00000	0.210257	-4.756	<0.0001	***
time	73.4753	15.1731	4.842	<0.0001	***
Mean dependent var	257.6867	S.D. dependent var		274.0782	
Mean of innovations	-0.531859	S.D. of innovations		26.80499	
R-squared	0.989762	Adjusted R-squared		0.986970	
Log-likelihood	-74.49870	Akaike criterion		160.9974	
Schwarz criterion	165.2457	Hannan-Quinn		160.9522	
	<i>Real</i>	<i>Imaginary</i>	<i>Modulus</i>	<i>Frequency</i>	
AR					
Root 1	0.9605	-0.2990	1.0059	-0.0480	
Root 2	0.9605	0.2990	1.0059	0.0480	
M					
A					
Root 1	1.0000	0.0000	1.0000	0.0000	

A coefficient of determination approaching unity indicates that the selected model's structure and the factors incorporated are correctly specified. These analyses confirm that the model adequately represents the underlying real-world processes. Based on these results, the primary forecast indicators for the development of the social sector in the Khorezm region for the period 2025–2030 have been generated Table 2.

Table 2. Forecasted values of the volume of social sector services in the Khorezm region

For 95% confidence intervals, $z(0.025) = 1.96$				
Years	Social services	Growth rate	Standard error	95% confidence interval
2025	1035,2	117,0	27,0	(981,5, 1088,9)
2026	1172,0	113,5	36,2	(1101,0, 1243,0)
2027	1292,5	110,5	41,0	(1212,0, 1373,0)
2028	1392,0	108,0	42,8	(1308,0, 1476,0)
2029	1470,5	105,5	43,1	(1386,0, 1555,0)
2030	1526,0	104,0	43,2	(1441,0, 1611,0)

The outcomes of the model worked out considering the current tendencies in development show that the level of social services in the Khorezm region is predicted to demonstrate a stable increase in the years. The initial estimations indicate that the indicator will grow by a factor of about 14.8 as compared to the last year in 2025. The growth rate is expected to slow down gradually in the following years and yield an expected 4.5 percent in 2030.

Overall, by the end of 2030, the volume of social services is projected to reach approximately 1,497.3 billion Uzbek soms, representing an increase of nearly 1.68 times compared to 2024. The relatively high growth observed during the initial years can be attributed to the rapid expansion of non-governmental entities within the sector and the corresponding broadening of the service market. In subsequent years, the relative saturation of the market is expected to lead to a natural stabilization of growth rates. Accordingly, these forecast results can be regarded as practically reliable and indicative

for policy and planning purposes.

To determine the actual level of social service development in the region, the share of these services in the overall national indicators was also examined. Forecasts for the forthcoming period were analyzed using multiple calculation scenarios, and the most optimal results were generated based on the method presented below.

$$TX_t = 3,15 + 1,74 * TXS_{t-1} - 0,97 * TXS_{t-2} - 1,95 * \varepsilon_{t-1} + 0,99 * \varepsilon_{t-2} \quad (2)$$

Here: TXS – The share of social services provided in the Khorezm region as a percentage of the national total;

The criteria necessary for assessing the model's adequacy were analyzed, and the results indicate that the calculated z-statistics for each factor fully meet the established requirements. The corresponding probability levels for these indicators were consistently well below 0.01, confirming the high reliability of the model parameters with an accuracy approaching 99.5%.

Moreover, a coefficient of determination of approximately 0.76 indicates that the factors included in the model account for 76% of the variation in the outcome variable. This demonstrates that the selected model sufficiently captures the overall dynamics of the process Table 3.

Table 3. The results of the selected model were used to compute the forecast values of the share of social services provided in the Khorezm region within the total volume of social services delivered at the national level

Model 18: ARMA, using observations 2010-2024 (T = 15)

Dependent variable: TXS

Standard errors based on Hessian

	Coefficient	Std. Error	z	p-value
<i>Const</i>	3.168	0.024	138.0	<0.0001 ***
<i>phi_1</i>	1.729	0.051	34.7	<0.0001 ***
<i>phi_2</i>	-0.957	0.038	-25.5	<0.0001 ***
<i>theta_1</i>	-1.942	0.332	-5.85	<0.0001 ***
<i>theta_2</i>	1.008	0.329	3.07	0.0024 ***
	<i>Real</i>	<i>Imaginary</i>	<i>Modulus</i>	<i>Frequency</i>
AR				
Root 1	0.8950	-0.4794	1.0153	-0.0783
Root 2	0.8950	0.4794	1.0153	0.0783
MA				
Root 1	0.9731	-0.2302	1.0000	-0.0370
Root 2	0.9731	0.2302	1.0000	0.0370

Considering the variability and instability of the data over the research period, the obtained results may be regarded as sufficiently reliable. Moreover, the MAPE (Mean Absolute Percentage Error) value of 5.1 confirms that the model meets the requirements for producing forecast estimates. Consequently, the forecast indicators generated on the basis of the selected model were presented in the following form Table 4.

Table 4. Forecast values of the share of social services provided in the Khorezm region within the total volume of social services at the national level

For 95% confidence intervals, $z(0.025) = 1.96$

Years	Share of social services	Difference compared to the previous year	Standard error	95-percent confidence interval
2025	2,4	-0,7	0,19441	(2,32474, 3,08745)
2026	2,1	-0,04	0,19978	(2,30245, 3,08241)
2027	2,4	0,05	0,20945	(2,37678, 3,19778)
2028	3,1	0,19	0,22165	(2,52746, 3,39741)
2029	3,23	0,24	0,2341	(2,72413, 3,630213)

2030 3,1 0,21 0,23445 (2,91978, 3,838864

The share of social services provided in the Khorezm region within the national total has demonstrated a declining trend over the past two years. Although this indicator has been 3.5 percent in 2022, it fell to 2.7 percent in 2024, which is a decline of 0.8 percentage points within the years. It also implies that the relative level of development in the region is falling behind in comparison to other provinces. As shown by the forecast results, the region share will be approximately 2.6 percent in 2025 and the downward trend is likely to be observed in the first years. Nonetheless, the share of social services is expected to possess positive dynamics beginning in 2027, and the figure will reach about 3.3 percent in 2030. However, this indicator is still lower than the highest value that was observed in the course of the research that was 3.6 percent. The analysis shows that beyond the changes in the service volume as quantitative changes, qualitative changes will occur in the future. This is because the activities of non-governmental service providers play a critical role in ensuring the growth rate and quality of social services in the region. Therefore, forecast values for important indicators reflecting the future development of social services in the Khorezm region were generated. Various model specifications were examined, and the option yielding the most optimal results was chosen as the basis.

$$TS_t = 1,89 * TS_{t-1} - 0,98 * TS_{t-2} - 0,99 * \varepsilon_{t-1} + 3,25 * t \quad (3)$$

TS – Number of individuals using social services in the Khorezm region, thousand persons;

To evaluate the reliability of the proposed model and the influence of its constituent factors, the adequacy of the estimated coefficients was thoroughly analyzed. The analysis confirmed that all coefficients fully satisfy the established criteria Table 5.

Table 5. Results of the selected model for forecasting the number of individuals using social services in the Khorezm region for 2025–2030

Model 15: ARMAX, using observations 2010–2024 (T = 15)

Dependent variable: ST

Standard errors based on Hessian

	<i>Coefficient</i>	<i>Std. Error</i>	<i>z</i>	<i>p-value</i>	
phi_1	1.895	0.042	45.45	<0.0002	***
phi_2	–0.986	0.015	–65.45	<0.0002	***
theta_1	–0.99999	0.302	–3.35	0.0004	***
Time	3.254	0.489	6.66	<0.0002	***
Mean dependent var	20.50667	S.D. dependent var		17.90911	
Mean of innovations	–0.418761	S.D. of innovations		1.942243	
R-squared	0.989017	Adjusted R-squared		0.986021	
Log-likelihood	–34.97802	Akaike criterion		79.95603	
Schwarz criterion	83.49629	Hannan-Quinn		79.91832	
	<i>Real</i>	<i>Imaginary</i>	<i>Modulus</i>	<i>Frequency</i>	
AR					
Root 1	0.9607	–0.3019	1.0070	–0.0485	
Root 2	0.9607	0.3019	1.0070	0.0485	
M					
A					
Root 1	1.0000	0.0000	1.0000	0.0000	

Therefore, it was considered unnecessary to conduct a comparative analysis. The results of these criteria confirm the reliability of the proposed model and demonstrate that it can be used to generate scientifically grounded forecast indicators. On this basis, the forecast values calculated using the model were presented in the following form Table 6.

Table 6. Forecast results for the number of individuals using social services in the Khorezm region
For 95% confidence intervals, $z(0.025) = 1.96$

Years	Number of students	Growth rate	Standard error	95% confidence interval
2025	67,50	111,5	1,95	(63,70, 71,30)
2026	73,10	108,3	2,61	(68,05, 78,15)
2027	77,05	105,4	2,95	(71,30, 82,80)
2028	79,35	102,9	3,08	(73,30, 85,40)
2029	80,00	100,8	3,10	(73,90, 86,10)
2030	79,30	99,1	3,11	(73,20, 85,40)

According to the forecast results, the number of individuals using social services in the Khorezm region is expected to maintain its growth rates and reach a maximum by 2029, amounting to approximately 79.8 thousand persons. In 2030, this figure is projected to decrease slightly by 0.9 percent compared to the previous year, reaching 79.1 thousand persons. At the same time, as coverage expands, the growth rates are expected to gradually decline. On the whole, the amount of the population using social services in the area will increase by 1.30 times within the year 2030 compared to the year 2024, which can be discussed as a positive result. Nonetheless, it is worth noting that as the number of users of the service increases, so should the adequacy of the service-providing staff. Consequently, the problems of personnel can occur in the next few years. According to the statistics data that can be calculated, even though in 20102011, the average number of users per employee was 14, it has increased to 28.9 in 20242025, which is more than two times greater. This means that service-providing organizations operating in the region are trying to address the demand using their available resources, but the problem is that as demand continues to increase, the challenge continues to be pertinent. With this situation in consideration, the results of the forecasts regarding the number of social service personnel were created. In the preparation of these forecasts, a model was analyzed, and the best model was found. On this basis, the following values were calculated as the forecast values.

$$(1 - L)PR_t = -71,78 - 0,99 * \varepsilon_{t-1} + 20,35 * t \quad (4)$$

PR – Number of social service personnel in the Khorezm region, persons;

The criteria used to assess the reliability of this model and their results are presented, all of which fall within the established requirements. The z-statistics for each coefficient confirm the model's adequacy, while the coefficient of determination indicates that the factors and the functional form of the model have been correctly specified.

Using this model, forecast values for social service personnel in the Khorezm region up to 2030 were generated Table 7.

Table 7. Results of the selected model for forecasting the number of social service personnel in the Khorezm region for 2025–2030

Model 17: ARMAX, using observations 2011-2024 (T = 14)

Dependent variable: (1-L) PR

Standard errors based on Hessian

Coefficient	Std. Error	Z	p-value		
const	-72.0500	15.3100	-4.70		
theta_1	-1.00010	0.22200	-4.51		
time	20.3600	1.75200	11.62		
	<i>Coefficient</i>	<i>Std. Error</i>	<i>z</i>	<i>p-value</i>	
Const	-72.0500	15.3100	-4.70	<0.0001	***
theta_1	-1.00010	0.22200	-4.51	<0.0001	***
Time	20.3600	1.75200	11.62	<0.0001	***
Mean dependent var	103.9486	S.D. dependent		117.7178	

Mean of innovations	2.976045	var S.D. of innovations	56.17674
R-squared	0.986056	Adjusted R- squared	0.984956
Log-likelihood	-77.61812	Akaike criterion	163.2312
Schwarz criterion	165.7911	Hannan-Quinn	162.9948
	<i>Real</i>	<i>Imaginary</i>	<i>Modulus</i> <i>Frequency</i>
MA			
Root 1	1.0002	0.0001	0.0001 0.0001

According to the forecast results, the number of personnel is expected to maintain stable growth rates in the coming years. Moreover, the stability of the growth rate, which is relatively high compared to the increase in the number of service users, allows for a partial mitigation of issues related to staff shortages.

The growth rate of personnel is projected to fluctuate between 11.7 and 10.3 percent, averaging 10.8 percent. As a result, by 2030, the number of active personnel in the region is expected to reach 3,880, which is 1.85 times higher than in 2024.

Using the forecasted values of both the number of social service personnel and their workload, the level of provision between personnel and service users in the coming years was assessed, and corresponding forecast indicators were generated Table 8.

Table 8. Forecasted values for the number of social service personnel in the Khorezm region

For 95% confidence intervals, $z(0.025) = 1.96$

Years	Number of faculty members	Growth rate	Standard error	95% confidence interval
2025	2310	111,0	56,18	(2200,1, 2420,2)
2026	2580	112,0	56,18	(2470,2, 2690,2)
2027	2880	111,5	56,18	(2770,0, 2990,0)
2028	3195	111,0	56,18	(3085,0, 3305,0)
2029	3525	110,6	56,18	(3415,0, 3635,0)
2030	3880	110,2	56,18	(3770,0, 3990,0)

Under the current conditions, an average of 29 service users correspond to one employee, which is nearly twice the established norm. Therefore, it is necessary to determine how this indicator is expected to change during the forecast period Picture1.

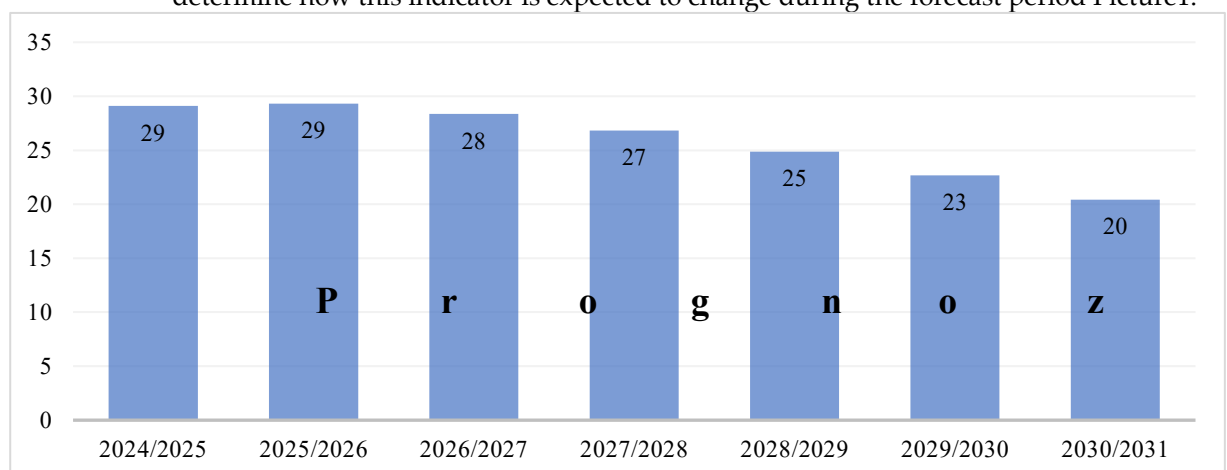


Figure 1. Average number of service users per employee in the Khorezm region, persons

The forecast results indicate that the number of service users per employee in the region is expected to decrease, from the current 29 persons to approximately 20 persons. However, this figure will still remain above the established norm, meaning that the existing issue will not be fully resolved, but its significance will be somewhat reduced.

4. Conclusion

In conclusion, the developed forecasts suggest that the growth rates of service volumes in the region will gradually slow down, while the region's overall share will continue to increase. This trend can be explained by the saturation of the service market at the national level. At the same time, alongside the increase in the number of personnel, a deceleration in the growth rate of service users is also observed. In the coming years, the stability of service growth rates is expected to be achieved, in part due to the expansion of services provided through non-governmental organizations, leading to the normalization of growth rates.

Primarily, the sustainable development of the social sector in the Khorezm region is one of the key factors contributing to the region's overall economic progress, the enhancement of human capital quality, improvement of living standards, and the maintenance of social stability. The forecasting processes were carried out taking into account the region's demographic characteristics, labor resource composition, available infrastructure, socio-economic potential, and external factors. The analysis demonstrates that the Khorezm region possesses substantial potential for the consistent development of its social sector, and prospective directions for ensuring its sustainability have been clearly identified.

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