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IMPROVING THE METHODOLOGY FOR POVERTY REDUCTION THROUGH INVESTMENT ATTRACTION IN REGIONAL ECONOMIES EVIDENCE FROM KASHKADARYA REGION

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Abstract: *This study focuses on improving the methodology for reducing poverty through investment attraction in regional economies, using Kashkadarya Region as a case study. The research examines investment attraction as an important instrument for stimulating regional economic growth, expanding employment opportunities, increasing household incomes, and reducing poverty. Particular attention is given to the relationship between investment activity and key socio-economic indicators, including gross regional product, employment, household income, and poverty levels. The study develops a methodological framework for assessing the socio-economic effectiveness of investment policy by combining statistical, comparative, correlation, and econometric approaches. The proposed methodology makes it possible to evaluate not only the volume of attracted investments but also their contribution to employment generation, income growth, productive capacity, and inclusive regional development. The analysis emphasizes that the poverty-reducing effect of investment depends on the sectoral structure of investment, the quality of infrastructure, the availability of human capital, and the capacity of local enterprises to participate in investment-generated value chains. Based on the analytical framework, the study identifies priorities for improving investment allocation toward employment-intensive and high-value-added sectors, supporting small and medium-sized enterprises, developing infrastructure, and strengthening local economic opportunities. The findings provide a methodological basis for developing a more targeted and outcome-oriented regional investment policy. The proposed approach can support policymakers in evaluating investment projects according to their potential contribution to sustainable poverty reduction and inclusive economic development in Kashkadarya Region.*

Keywords: *investment attraction, poverty reduction, regional economy, investment policy, econometric assessment, employment, household income, economic growth, regional development, Kashkadarya.*

INTRODUCTION

In the contemporary global economy, poverty reduction has become one of the most important priorities of regional development policy. The persistence of income inequality, differences in employment opportunities, uneven infrastructure development, and disparities in access to economic resources demonstrate that poverty cannot be addressed exclusively through social assistance mechanisms. Sustainable poverty reduction requires the creation of stable sources of income, productive employment, expansion of entrepreneurial activity, and improvement of regional economic capacity. In this context, investment attraction represents one of the most important economic instruments for strengthening the productive potential of regions and creating long-term opportunities for improving household welfare. Investment contributes to regional development

through several interconnected mechanisms. The inflow of investment into manufacturing, agriculture, services, infrastructure, logistics, and other sectors increases production capacity, stimulates business activity, creates new jobs, and supports the development of local value chains. At the household level, these processes can increase employment and labor income, thereby improving living standards and reducing poverty.

However, the relationship between investment and poverty reduction is not automatic. The socio-economic effect of investment depends on its sectoral structure, geographical distribution, technological characteristics, employment intensity, infrastructure conditions, and the ability of local enterprises and the population to participate in investment-related economic activities. These issues are particularly relevant for regional economies characterized by significant differences in economic potential and social development. Kashkadarya Region has substantial natural, agricultural, industrial, tourism, and service-sector potential, creating favorable conditions for attracting domestic and foreign investment. At the same time, the effectiveness of investment attraction should be assessed not only according to the amount of capital mobilized but also according to its contribution to employment creation, household income growth, economic diversification, and poverty reduction.

Therefore, improving the methodological foundations for assessing the relationship between investment attraction and poverty reduction is an important scientific and practical task. A major methodological challenge is determining the channels through which investment affects poverty. Investment may directly increase economic activity, while its indirect effects can emerge through employment expansion, productivity growth, development of small and medium-sized enterprises, infrastructure improvement, and increased household income. Accordingly, the assessment of investment effectiveness requires a comprehensive approach that combines regional economic indicators with poverty-related measures. Statistical, comparative, correlation, and econometric methods can provide an appropriate analytical basis for identifying the strength and direction of these relationships. The relevance of this research is also associated with the need to move from a quantitative approach to investment attraction toward an outcome-oriented investment policy. Under such an approach, the effectiveness of investment projects is determined not simply by their financial scale, but by their capacity to generate sustainable employment, increase real incomes, stimulate local production, and expand economic opportunities for vulnerable population groups. This requires identifying investment priorities that correspond to the specific economic and social characteristics of the region.

The purpose of this study is to improve the methodology for poverty reduction through investment attraction in regional economies based on the case of Kashkadarya Region. The study focuses on identifying the relationship between investment activity and key socio-economic indicators, assessing the mechanisms through which investment contributes to poverty reduction, and developing methodological recommendations for improving the effectiveness of regional investment policy. The scientific significance of the research lies in developing an integrated methodological approach that connects investment activity with poverty reduction through economic growth, employment, and household income. The practical significance consists in providing an analytical basis for policymakers to improve the allocation of investment resources, support employment-generating sectors, strengthen local business activity, and promote more inclusive and sustainable regional economic development.

LITERATURE REVIEW

The relationship between investment attraction and poverty reduction has become an increasingly important area of research in regional economics. Contemporary studies generally move beyond the traditional assumption that investment affects poverty only through aggregate economic growth. Recent literature increasingly emphasizes the employment, household income, productivity, infrastructure, entrepreneurship, institutional quality, and spatial development channels through which investment can influence poverty. This broader perspective is particularly relevant for regional economies, where the same volume of investment can generate substantially different social

outcomes depending on the economic structure and institutional environment of a territory. One of the important directions in recent international research is the examination of the relationship between foreign direct investment (FDI), employment and poverty reduction. Recent econometric research on selected ECOWAS countries identifies a strong interaction between FDI inflows, employment generation and poverty reduction.

The authors emphasize that FDI can contribute to poverty alleviation through employment creation and that the effects may occur with time lags, which should be considered when designing investment policies [1]. This conclusion is important for regional research because it demonstrates that investment effectiveness should not be measured only by immediate changes in output or capital formation. Instead, the employment and income effects of investment should also be incorporated into the assessment. The nonlinear character of the investment–poverty relationship has also received increasing attention. A recent global regional study using fixed-effects, random-effects and System GMM approaches for 198 countries during 2002–2021 demonstrates that the determinants of economic deprivation differ across geographical regions. The research highlights the importance of political stability and other macroeconomic factors in determining the extent to which investment and economic activity translate into improvements in welfare [2]. This finding suggests that investment policy cannot be isolated from the broader institutional and macroeconomic environment. Another important strand of the literature examines regional heterogeneity. Contemporary regional development research emphasizes that poverty is spatially concentrated and that economic opportunities are unevenly distributed across territories.

Consequently, uniform investment policies may produce different outcomes depending on infrastructure availability, labor-market conditions, human capital, market accessibility and entrepreneurial capacity. This provides a theoretical basis for developing region-specific methodologies for assessing the poverty-reducing effects of investment. The World Bank's recent analytical work on Uzbekistan provides important evidence concerning the relationship between economic reforms, investment and poverty. According to the World Bank's 2024 Macro Poverty Outlook, Uzbekistan's economy expanded by approximately 6% in 2023, while strong real wage growth contributed to poverty reduction. The institution also emphasizes that ongoing structural reforms are expected to improve the business environment and stimulate private-sector-led investment [3]. These findings suggest that investment policy should be viewed as part of a broader structural transformation process rather than as an isolated instrument. The World Bank's comparative assessment of Uzbekistan's poverty trajectory is particularly relevant to the present research. Knight, Pimhidzai and Uochi (2024) note that Uzbekistan substantially improved its poverty measurement system and introduced internationally comparable poverty estimates.

Their analysis provides a basis for evaluating the country's progress in poverty reduction within an international framework and emphasizes the importance of comparable statistical indicators for assessing policy effectiveness [4]. For regional studies, this methodological development is important because reliable poverty indicators are essential for econometric assessment. The Asian Development Bank (ADB) also places investment at the center of Uzbekistan's economic transformation. Its assessment indicates that higher investment and strong industrial expansion supported Uzbekistan's economic growth in 2023, while continued investment in industry, agriculture and capital formation was expected to support subsequent growth [5]. At the same time, ADB stresses the importance of maintaining inclusive and sustainable growth. This implies that investment should be evaluated not only through its contribution to GDP but also through its broader impact on living standards and employment.

The relationship between poverty reduction and financial inclusion represents another important direction in the recent literature. ADB's assessment of Uzbekistan's inclusive finance development indicates that the country's poverty rate declined substantially over the longer term, while microenterprise incomes, wage growth and improvements in social protection contributed to improvements in living standards [6]. The study also points to the importance of small and medium-sized enterprises as a source of employment and economic activity. Consequently, investment

policies that improve access to finance for SMEs can have an indirect but significant effect on poverty reduction. Recent research on Uzbekistan's international investment and trade confirms the importance of FDI and economic diversification. Ashurova (2025) argues that international trade and foreign direct investment have contributed to poverty reduction through employment creation, industrial diversification, income growth and improved access to economic opportunities [7]. The study particularly emphasizes the changes that occurred after the economic reforms initiated in 2017. At the same time, it points to regional inequality and institutional constraints as factors that may limit the poverty-reducing effect of investment.

This argument is consistent with the broader international literature, which increasingly considers investment quality more important than investment quantity alone. A large investment project may substantially increase regional output but generate relatively few jobs if it is highly capital-intensive. In contrast, investment directed toward manufacturing, services, agriculture processing, logistics, tourism and small business can create broader employment and income multipliers. Therefore, an effective regional investment methodology should incorporate indicators reflecting the social and economic outcomes of investment projects. Recent research specifically focused on regional poverty mechanisms in Uzbekistan has begun to develop more integrated measurement approaches. Saparov (2026), examining the Surkhandarya region for 2015–2025, proposed an Integral Investment-Poverty Reduction Index (IKII) that combines investment activity, poverty reduction, infrastructure development, small-business coverage and social protection effectiveness [8]. This approach is particularly relevant to the present research because it demonstrates the possibility of moving from a single-variable assessment toward a multidimensional evaluation of investment-related poverty reduction. The importance of private-sector investment and institutional reforms is also highlighted in recent World Bank assessments.

The World Bank's 2024 reform program for Uzbekistan emphasizes stronger investor protection, improved investor services, greater private-sector participation, and the attraction of both domestic and foreign investment [9]. The institution also connects investment reforms with infrastructure modernization, energy-sector development, agricultural productivity and protection of vulnerable population groups. This indicates that investment policy can contribute to poverty reduction through several interconnected economic and institutional mechanisms. The role of private-sector development is further emphasized in the World Bank's broader assessment of Uzbekistan's current development trajectory. The country has maintained strong economic growth since the beginning of market-oriented reforms, but job creation has not always kept pace with economic growth. The World Bank therefore emphasizes the need for additional productive and better-paid jobs, improved business conditions, private-sector development and investment reforms [10]. This observation is highly relevant to the present study because it demonstrates that economic growth alone is insufficient for sustainable poverty reduction unless growth translates into employment and income opportunities. ADB's 2024–2028 Country Partnership Strategy for Uzbekistan similarly places emphasis on private-sector development, competitiveness, human-capital investment and the transition toward an inclusive green economy [11].

The strategy explicitly links these priorities with the objective of sustaining economic expansion and reducing poverty. Thus, recent development-policy literature increasingly converges around the idea that investment, human capital, private-sector development and poverty reduction should be considered as components of a single regional development system. The reviewed literature allows the main theoretical approaches to the investment–poverty relationship to be grouped into several categories. First, the economic growth approach considers investment as a source of capital accumulation and expansion of production. Under this approach, investment increases productive capacity and regional output, which can eventually improve living standards. Second, the employment-income approach emphasizes the labor-market mechanism. Investment creates employment opportunities, increases wages and household incomes, and thereby contributes directly to poverty reduction [1,7]. Third, the structural transformation approach focuses on investment-driven diversification. Investment in manufacturing, services, infrastructure and new economic

activities reduces dependence on low-productivity sectors and creates more sustainable sources of income [5,7]. Fourth, the institutional approach emphasizes the importance of investor protection, governance, financial access and business conditions. The poverty-reducing effect of investment is stronger when institutional mechanisms allow households and local enterprises to participate in investment-generated economic opportunities [3,9]. Fifth, the spatial approach emphasizes differences between regions. Investment effectiveness depends on infrastructure, human capital, market access and the initial level of economic development. Therefore, regional investment policy should be differentiated according to local conditions.

Table 1.

Selected recent approaches to investment-led poverty reduction⁴

Author/Institution	Year	Main focus	Methodological contribution	Key implication
ECOWAS study	2024	FDI, employment and poverty	Dynamic stochastic panel analysis	FDI, employment and poverty reduction are interconnected
Global regional study	2024	FDI and economic deprivation	FE, RE and System GMM	Effects differ across regions
World Bank	2024	Uzbekistan's poverty and growth	Macro-poverty analysis	Real income and structural reforms support poverty reduction
Knight, Pimhidzai & Uochi	2024	Poverty measurement in Uzbekistan	International comparison	Comparable poverty indicators improve policy assessment
ADB	2023	Investment and economic growth	Macroeconomic assessment	Investment supports industrial and economic expansion
Ashurova	2025	Trade, FDI and poverty	Qualitative empirical analysis	Investment contributes through jobs and diversification
Saparov	2026	Investment and regional poverty	Integral index	Multidimensional assessment improves regional policy analysis

Despite the growing body of literature, several research gaps remain. First, many international studies analyze the investment–poverty relationship at the national level, while regional differences receive comparatively less attention. Second, investment is frequently considered separately from employment, household income, infrastructure and small-business development, although these factors form interconnected transmission mechanisms. Third, there remains a need for methodological approaches that can evaluate not simply the amount of investment attracted by a region but its socio-economic effectiveness. For Kashkadarya Region, this research gap is particularly significant. A regional methodology should take into account the territory's sectoral structure, investment potential, employment characteristics, infrastructure capacity, entrepreneurial environment and differences in household welfare.

Consequently, the assessment of investment effectiveness should incorporate both

⁴ Compiled by the author based on [1–8].

quantitative indicators, such as investment volume and GRP, and qualitative or outcome-based indicators, including employment creation, income growth and poverty reduction. Based on the reviewed literature, the present study proposes to treat investment attraction as a multidimensional mechanism of poverty reduction rather than merely a source of capital accumulation. The methodological framework therefore connects investment with regional economic growth, employment and household income and considers these variables as interconnected channels of poverty reduction. This approach is consistent with the recent international trend toward inclusive and outcome-oriented regional development.

The literature review also indicates that future empirical research should increasingly employ panel-data and spatial econometric methods, particularly where data for multiple regions and years are available. Such methods can help distinguish the immediate and delayed effects of investment, identify regional spillovers, and account for differences in initial development conditions. For Kashkadarya Region, this approach can provide a stronger empirical basis for determining which types of investment have the greatest potential to generate employment and reduce poverty. Overall, recent international, institutional and Uzbekistan-focused studies confirm that investment can be an important driver of poverty reduction, but its effectiveness depends on investment structure, employment intensity, income distribution, infrastructure, private-sector participation and institutional quality. The main scientific gap is therefore not simply whether investment reduces poverty, but under what regional conditions, through which mechanisms, and with what degree of effectiveness investment contributes to sustainable poverty reduction. Addressing this gap forms the methodological foundation of the present study on Kashkadarya Region.

METHODOLOGY

The study was conducted to improve the methodology for reducing poverty through investment attraction in regional economies, with empirical evidence from the Kashkadarya Region. The research methodology was designed to identify the relationship between investment activity, regional economic growth, and changes in the poverty rate. A quantitative research design was applied because it allowed the dynamics of the main indicators to be measured and the statistical relationship between investment and poverty reduction to be empirically assessed. The empirical analysis was based on annual statistical data for the period 2010–2024. The observation period was selected because it provided a sufficiently long time series for identifying changes in investment activity and poverty dynamics in the region. The main dependent variable was the poverty rate (%), while the principal explanatory variable was the volume of investment in fixed capital (billion UZS).

Additional indicators included investment financed by enterprises' own funds, foreign loans, and household funds. The gross regional product (GRP) was also incorporated into the analysis as an indicator of regional economic development. The data were systematized in chronological order and transformed into a comparable analytical form. Descriptive statistical methods were initially used to determine the mean, minimum, maximum, and standard deviation of the variables. This procedure made it possible to evaluate the scale and variability of investment and poverty indicators during the study period. The dynamics of the variables were subsequently analyzed using growth rates and year-to-year changes. To assess the relationship between investment and poverty reduction, a correlation analysis was conducted.

The Pearson correlation coefficient was used to determine the direction and strength of the relationship between the poverty rate and the selected investment and economic indicators. A negative correlation between investment activity and poverty was interpreted as an indication that increasing investment was associated with a reduction in the poverty rate. At the same time, correlation analysis was not treated as evidence of causality; therefore, regression analysis was subsequently applied. The econometric component of the research was based on a multiple linear regression model. The general specification of the model was expressed as follows:

$$P_t = \beta_0 + \beta_1 INV_t + \beta_2 GRP_t + \beta_3 EMP_t + \varepsilon_t$$

The model was selected because poverty reduction in a regional economy was not determined

by investment alone. Investment could influence poverty through several interconnected channels, including employment creation, expansion of production capacity, growth of household incomes, development of infrastructure, and diversification of regional economic activity. Therefore, the inclusion of GRP and employment-related variables allowed the direct relationship between investment and poverty to be considered within a broader regional economic framework. Particular attention was paid to the structure of investment financing. Investment financed from enterprises' own resources, foreign credit resources, and household funds was analyzed separately. This approach was applied because different sources of financing could have different effects on poverty reduction. Enterprise investment could contribute to the expansion of production and employment, foreign financing could support modernization and new investment projects, while household investment could reflect the participation of the population in economic activity and housing-related development.

The study also used comparative and structural analysis. Comparative analysis was applied to determine changes in the investment environment and poverty indicators between the beginning and end of the observation period. Structural analysis was used to examine the contribution of different financing sources to total investment. These methods were selected because they allowed not only the volume of investment to be measured but also the qualitative transformation of the regional investment structure to be identified. The methodological framework also included trend analysis to determine the long-term direction of changes in investment and poverty. The trend approach was particularly important because annual fluctuations could have been caused by temporary economic conditions. By considering the entire 2010–2024 period, the study was able to distinguish longer-term tendencies from short-term variations. The statistical and econometric calculations were performed using quantitative data-processing and econometric techniques. The estimated coefficients were evaluated according to their signs, magnitude, and statistical significance. The coefficient of determination (R^2) was used to assess the explanatory capacity of the regression model, while statistical significance tests were applied to determine whether the estimated relationships were sufficiently reliable. The model results were interpreted in economic rather than purely statistical terms.

To ensure the reproducibility of the research, the analytical procedure followed several consecutive stages. First, annual data on investment, GRP, poverty, and related indicators were collected and organized. Second, descriptive statistics and dynamic indicators were calculated. Third, correlation coefficients were estimated to identify preliminary relationships between the variables. Fourth, a multiple regression model was specified and estimated. Fifth, the obtained coefficients and statistical indicators were interpreted in terms of their economic meaning. Finally, the empirical findings were used to formulate methodological recommendations for improving investment-based poverty reduction policies in the Kashkadarya Region.

The selected methodology was considered appropriate because it combined descriptive, comparative, structural, correlation, trend, and econometric methods within a unified analytical framework. Such an approach made it possible to move from a simple description of investment and poverty dynamics toward an empirical assessment of the mechanisms through which investment activity could contribute to poverty reduction. The methodology therefore provided an analytical basis for developing region-specific recommendations aimed at improving the efficiency of investment attraction and strengthening its social and economic impact.

ANALYSIS AND RESULTS

Poverty reduction in the Republic of Uzbekistan for 2010-2025 has become one of the main priorities of state policy. In particular, the strategy "Uzbekistan - 2030" sets the task of doubling the income of the population and significantly reducing the level of poverty. Kashkadarya region, as the southern region of the country, has its own unique socio-economic characteristics. The presence of foothill and steppe areas in the region, stable population growth, changing shares of industry and agriculture in the economy, as well as uneven development of infrastructure across regions are

important factors affecting the level of poverty and its dynamics. The main problem under consideration is which of the economic, social, infrastructural and demographic factors affecting the level of poverty is the most important in the conditions of the Kashkadarya region, the degree of quantitative correlation between them and the direction of influence have not been scientifically studied. The relevance of the research problem is explained by several factors:

1. Existing studies have been conducted mainly at the republican level, and regional differences have not been sufficiently analyzed.
2. The quantitative assessment of the impact of factors is unclear - there is no clear statistical data on how much each factor (investments, incomes, education, infrastructure, etc.) reduces poverty.
3. It has not been determined which factors should be given priority in the context of limited resources.
4. The impact of local characteristics (population composition, employment structure, geographical location) on poverty has not been sufficiently studied.

In order to solve these problems, answers to a number of scientific questions are sought within the framework of the study. In particular, it will determine the impact of economic factors such as investments, construction, income and business activity on the poverty rate in Kashkadarya region. It will also assess the role of infrastructural factors such as drinking water, electricity, lighting and housing in reducing poverty. The study will also examine the impact of preschool education, general education, higher education and the health care system on the poverty rate. In addition, it will analyze the importance of demographic factors such as population size and housing area in shaping the dynamics of poverty. At the same time, it will identify the factors that contributed the most to the reduction in poverty rate during 2010–2025. The purpose of the study is to determine the quantitative relationship between the poverty level and the economic, social, infrastructural and demographic factors affecting it, based on statistical data generated for the Kashkadarya region for 2010–2025, to identify the most important determinants of poverty, and to develop scientifically based recommendations for poverty reduction. During 2010–2025, the poverty level in the Kashkadarya region showed a steady downward trend. According to the results of the analysis, the poverty level decreased from 28.9 percent in 2010 to 6.5 percent in 2025, with a total reduction of 22.4 percentage points. According to calculations, the average annual decrease in the poverty level was about 1.49 percentage points. In particular, the reduction in the poverty rate from 23.2 percent to 12.0 percent between 2019 and 2020 indicates that the reduction in poverty during this period coincided with changes in socio-economic indicators.

During the analyzed period, a positive growth trend was observed in all economic indicators. The volume of investments increased from 1792.8 billion soums in 2010 to 11367.8 billion soums in 2025, an increase of 9575 billion soums. Similarly, the volume of construction works increased from 699.2 billion soums to 5100.2 billion soums, an increase of 4401 billion soums. Per capita income increased from 1,136.7 thousand soums to 8,750.4 thousand soums, an increase of 7,614 thousand soums.

The number of newly established enterprises reached 485 in 2025, while the level of economic activity increased from 65.4 percent to 72.8 percent. These results are characterized by increased investment activity in the regional economy, expansion of economic resources, and an increase in population incomes. In particular, the more rapid growth of investment, construction, and income indicators after 2019–2020 coincides in time with a sharp reduction in poverty. The dynamics of infrastructure indicators also show mainly positive trends. Electricity consumption increased from 1399.9 kWh to 2150.6 kWh, the indicator of lighting networks from 33448 units to 42150 units, and housing provision from 14.3 m² to 19.2 m² per capita.

However, a peculiar situation was observed in the indicator of drinking water supply. This indicator decreased from 82.1 percent in 2010 to 41.8 percent in 2025, and a particularly sharp decrease was noted in 2020 from 75 percent to 35 percent. At the same time, the fact that the poverty rate continued to decline indicates the need for a separate scientific analysis of the relationship

between this indicator and poverty. This may be due to changes in statistical calculation methodology or institutional reforms in the sector. Analysis of social sector indicators shows that there has been significant development in the education and healthcare infrastructure. The number of school places has increased from 0.7 thousand to 15.2 thousand, while the number of preschool educational institutions has increased from 355 to 520.

The increase in the number of higher education institutions from 2 to 11 is a particularly noteworthy result. The sharp increase in the number of higher education institutions mainly falls on the period after 2019. At the same time, the number of hospital beds has increased from 260 to 445, and outpatient services have gradually developed in recent years. In general, the expansion of social infrastructure is one of the factors contributing to the improvement of the quality of human capital. Analysis of demographic indicators shows that the population of Kashkadarya region has been steadily growing. The population increased from 2,616.1 thousand people in 2010 to 3,320.5 thousand people in 2025, with a total increase of 704.4 thousand people. The average annual population growth during this period was about 47 thousand people. At the same time, the area of housing has almost doubled, increasing from 854.8 thousand m² to 1,650.3 thousand m². This indicates that the housing stock has expanded along with the population growth.

The results of the trend analysis show that the reduction in poverty in Kashkadarya region during 2010–2025 coincided with the expansion of investment, the activation of construction activities, the increase in population incomes, the development of the higher education system, the increase in electricity consumption, and the improvement of housing provision. In particular, the rapid growth of economic and social indicators between 2019 and 2022 coincided with a significant reduction in poverty.

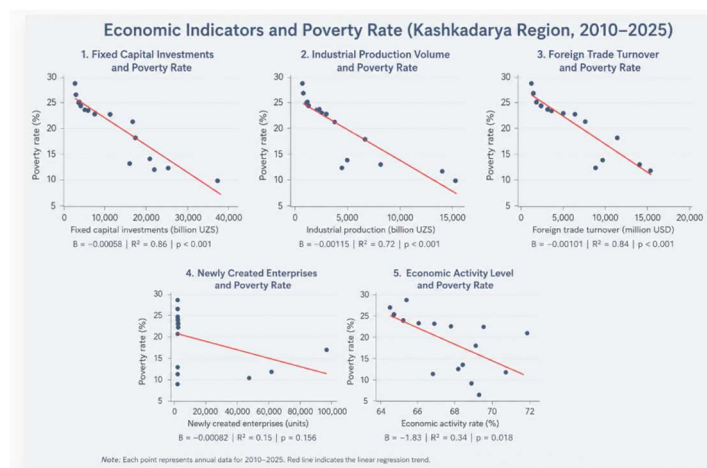


Figure 1. The impact of economic factors on poverty rates and regression correlations in Kashkadarya region (2010–2025)⁵

The relationship between the volume of investments in fixed capital and the poverty rate in Kashkadarya region is illustrated. The graphical data show that the poverty rate decreases with increasing investment volume. The relatively dense location of the points around the regression line indicates the presence of a stable inverse relationship between these factors. According to the results of the regression analysis, the regression coefficient on investments was $B = -0.00058$. This means that when the volume of investments increases by 1 billion soums, the poverty rate decreases by an average of 0.00058 percent.

The coefficient of determination is $R^2 = 0.86$, and 86 percent of the changes in the poverty rate are explained by changes in the volume of investments. The value $p < 0.001$ confirms the statistically significant value of the result. The results show that there is a strong inverse relationship between investments and poverty. During the study period, an increase in the volume of investments was observed along with a consistent decrease in the poverty level. In this regard, investments were shown

⁵ Compiled by the author based on the results of the Stata program

as one of the most important economic factors affecting the poverty level in Kashkadarya region.

In this regard, investments are assessed as one of the main economic determinants with a strong inverse relationship with the poverty level in Kashkadarya region. The relationship between the volume of construction work and the poverty level is reflected. The graph shows that as the volume of construction work increases, the poverty level decreases. The fact that the regression line has a negative direction indicates that there is an inverse relationship between the factors. According to the regression results, the regression coefficient for construction work was $B=-0.00115$. This means that when the volume of construction work increases by 1 billion soums, the poverty rate decreases by an average of 0.00115 percent. The coefficient of determination is $R^2=0.72$, and 72 percent of the change in the poverty rate is explained by the volume of construction work.

The value $p<0.001$ indicates that the result is statistically significant. The results confirm the existence of a strong inverse relationship between the volume of construction work and the poverty rate. During the study period, an increase in the volume of construction was observed along with a decrease in the poverty rate. Thus, the expansion of construction activity in the Kashkadarya region was manifested in a statistically significant inverse relationship with a decrease in the poverty rate. The relationship between per capita income and the poverty rate is illustrated. The graphic data show that the poverty rate decreases as income increases.

The location of the points along the regression line indicates a high level of correlation. According to the results of the regression analysis, the regression coefficient $B=-0.00101$. This means that when income increases by 1 thousand soums, the poverty rate decreases by an average of 0.00101 percent. The coefficient of determination $R^2=0.84$, which means that 84 percent of the change in poverty is explained by income. The value $p<0.001$ indicates that the result is statistically reliable. The results show that there is a strong inverse relationship between income and poverty. During the study period, the increase in income was observed at the same time as the decrease in poverty. In turn, per capita income appeared as a direct economic determinant with a strong inverse relationship with poverty.

The relationship between the number of newly established enterprises and the poverty rate is shown in the graph by the scattered location of the points around the regression line. According to the regression results, although the regression coefficient $B=-0.00082$, the coefficient of determination $R^2=0.15$ was recorded. $p=0.156$, which is above the level of statistical significance. These results indicate that there is no statistically significant relationship between the number of newly established enterprises and the poverty rate. That is, the change in the number of new enterprises in the Kashkadarya region does not directly affect poverty, but their impact may be indirectly manifested through employment and income.

Another indicator represented in the graphic image is the relationship between the level of economic activity and the poverty rate. The data show that poverty rates decrease with increasing economic activity. According to the results of the regression analysis, the regression coefficient $B=-1.83$. This means that when the economic activity rate increases by 1 percent, the poverty rate decreases by an average of 1.83 percent. The coefficient of determination is $R^2=0.34$, indicating that the poverty rate

Table 2

A generalized assessment of the results of regression analysis on economic factors affecting the level of poverty in Kashkadarya region⁶

Factor	B Coefficient	R^2	Strength of Relationship	Scientific Interpretation
Fixed Capital Investment	-0.00058	0.86	Strong negative	Investment in fixed capital is one of the most important economic factors contributing to poverty reduction.

⁶ Stata program results

Construction Activity	-0.00115	0.72	Strong negative	An increase in construction activity is associated with a reduction in the poverty rate.
Per Capita Income	-0.00101	0.84	Strong negative	Growth in per capita income represents a direct factor in reducing the poverty rate.
Newly Established Enterprises	-0.00082	0.15	Weak relationship	No statistically reliable relationship between the number of newly established enterprises and poverty reduction was identified.
Economic Activity	-1.83	0.34	Moderate negative	Higher economic activity is associated with a moderate reduction in the poverty rate.

Thus, among economic factors, investments ($R^2=0.86$) and per capita income ($R^2=0.84$) showed the highest indicators in explaining the level of poverty. Construction work also had a significant impact, amounting to $R^2=0.72$. While the impact of economic activity was assessed at a moderate level ($R^2=0.34$), no statistically significant relationship was found for the number of newly established enterprises ($R^2=0.15$; $p=0.156$). Thus, the results of the study show that investments and incomes are the most important economic factors in reducing poverty in the Kashkadarya region.

While investments, population incomes and construction activities played an important role in reducing poverty in the region, it is necessary to separately analyze the impact of infrastructure sectors developing along with economic growth on this process. In particular, the level of provision of drinking water, electricity, lighting, and housing to the population are important infrastructural factors that directly and indirectly affect the level of poverty. Below, the relationship between these factors and poverty is assessed based on regression analysis.

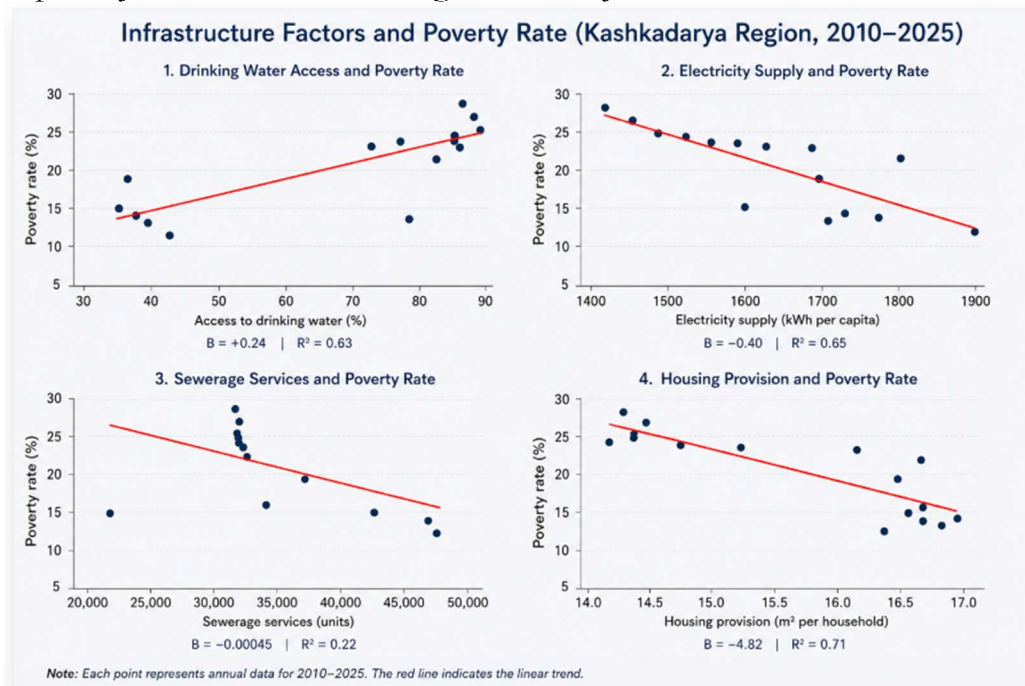


Figure 2. The impact of infrastructural factors on poverty and regression correlations in Kashkadarya region (2010–2025)⁷

⁷ Compiled by the author based on the results of the Stata program

According to the results of the analysis of the impact of infrastructure factors on the level of poverty, the coefficient of determination for the drinking water supply indicator in Kashkadarya region was $R^2=0.63$. This means that 63 percent of the changes in the poverty level are explained by this factor. The regression coefficient $B=+0.24$, which showed a positive value. This result is unexpected in terms of economic content, since usually an improvement in drinking water supply should be associated with a decrease in the level of poverty. This situation is explained by the fact that after 2020, the drinking water supply indicator decreased from 75 percent to 35 percent, and the poverty level also decreased.

Therefore, it is appropriate to assess this relationship not as a direct cause-and-effect relationship, but as a result of structural changes in the statistical series or methodological features. Thus, the positive relationship observed for the drinking water indicator can be explained by methodological features or structural changes in the statistical series and should be assessed together with other infrastructure factors. Electricity consumption was also found to have a significant inverse relationship with the level of poverty. In particular, the regression coefficient for this factor was $B=-0.040$, the coefficient of determination $R^2=0.65$, and the statistical significance level was $p<0.001$.

The results show that the increase in electricity consumption was accompanied by a decrease in the level of poverty. The fact that 65 percent of the changes in the level of poverty were explained by this factor confirms that electricity consumption is one of the important indicators of infrastructural development. The results obtained for the number of lighting equipment showed a relatively low correlation. The values of $R^2=0.22$ and $p=0.076$ were recorded for this factor. The low coefficient of determination and the level of statistical significance above the 0.05 threshold indicate that the impact of this factor on the level of poverty is limited. Accordingly, the number of lighting equipment is not among the main determinants explaining the level of poverty and did not have a statistically significant impact on the level of poverty. Finally, among the infrastructure factors, the highest impact was observed in the housing supply indicator. The regression coefficient for this factor was $B=-4.82$, the coefficient of determination $R^2=0.71$, and the level of statistical significance $p<0.001$. According to the results, when the level of housing provision increases by 1 m²/capita, the poverty rate decreases by an average of 4.82 percent.

It can be seen that this factor occupies a leading position among the infrastructural determinants, explaining 71 percent of the changes in poverty. Thus, the improvement of housing conditions was shown to be the infrastructural factor most closely related to the reduction in the poverty rate. According to the results, among the infrastructure factors, housing ($R^2=0.71$) and electricity consumption ($R^2=0.65$) showed the highest indicators in explaining the level of poverty. Although a high correlation was found for the indicator of drinking water supply ($R^2=0.63$), the positive value of the regression coefficient indicates the need to interpret this result with particular caution. The number of lighting equipment did not have a statistically significant effect on the level of poverty. Thus, the results of the study indicate that housing and electricity consumption are the most important infrastructure factors in reducing poverty in the Kashkadarya region.

DISCUSSION

The empirical analysis of infrastructure factors and poverty in Kashkadarya Region over the period 2010–2025 provides important evidence concerning the role of infrastructure development in improving socio-economic conditions and reducing poverty. The results obtained from the correlation and linear regression analysis demonstrate that infrastructure indicators do not affect poverty uniformly. The direction and strength of their relationships with the poverty rate differ depending on the type of infrastructure, its accessibility, territorial distribution, and the extent to which infrastructure development is transformed into improvements in household welfare. Therefore, the findings suggest that poverty reduction should not be based exclusively on increasing the volume of infrastructure investment. Greater attention should also be given to the quality, affordability, accessibility, and spatial distribution of infrastructure services. The regression analysis presented in the study shows that access to drinking water, electricity supply, sewerage services, and housing

provision have different relationships with the poverty rate. Among these indicators, housing provision demonstrates the strongest explanatory relationship, followed by electricity supply, while sewerage services have a relatively weaker relationship.

The result for drinking-water access is positive, which requires a more detailed economic interpretation rather than being treated simply as evidence that improved water infrastructure increases poverty. The relationship between access to drinking water and poverty was estimated as positive, with a regression coefficient of $B = +0.24$ and $R^2 = 0.63$. The relatively high coefficient of determination indicates that a considerable share of the variation in the poverty rate is statistically associated with changes in this indicator during the analyzed period.

However, the positive direction should be interpreted carefully because it does not necessarily mean that better access to drinking water causes an increase in poverty. One possible explanation is related to the territorial and demographic concentration of infrastructure investment. Infrastructure projects may have been implemented more intensively in territories experiencing rapid population growth, urbanization, migration, or relatively high levels of socio-economic vulnerability. In such circumstances, an increase in water-service coverage can occur simultaneously with a high or temporarily increasing poverty rate. Consequently, the observed positive association may reflect the joint influence of demographic and territorial factors rather than a direct adverse effect of water infrastructure. Another important issue is that the availability of infrastructure does not automatically guarantee its effective use by low-income households. The poverty-reducing effect of drinking-water infrastructure depends on the affordability of tariffs, reliability of supply, quality of water, connection costs, and the regularity of service provision.

Therefore, infrastructure policy should move from a purely quantitative approach based on coverage indicators toward a quality- and accessibility-oriented approach. From a regional policy perspective, this result indicates that investment in water infrastructure should be targeted particularly toward low-income and underserved communities. Such targeting can strengthen the transmission mechanism through which infrastructure investment affects household welfare. In other words, the effectiveness of water infrastructure should be assessed not only by the number of connected households but also by its contribution to reducing household expenditures, improving health conditions, and increasing the productive time available to economically active members of households. The analysis reveals a relatively strong negative relationship between electricity supply and the poverty rate, with $B = -0.40$ and $R^2 = 0.65$. This finding indicates that improvements in electricity availability are associated with reductions in poverty. The relatively high R^2 value suggests that electricity supply represents one of the important infrastructure-related factors explaining changes in the poverty rate during the study period.

The economic mechanism behind this relationship is multidimensional. Reliable electricity is an essential input for household consumption, education, healthcare, communication, and entrepreneurial activity. For low-income households, improved electricity availability can reduce the constraints associated with studying, working, and operating small-scale businesses. At the regional level, reliable electricity also improves the operating conditions of enterprises, facilitates technological modernization, and contributes to the creation and preservation of employment. The negative coefficient therefore supports the assumption that energy infrastructure constitutes an important component of inclusive regional development. Where electricity supply is reliable and affordable, households and businesses obtain greater opportunities to participate in economic activity. This can increase labor productivity and household income, thereby contributing to poverty reduction.

However, the results also suggest that electricity infrastructure should be considered together with other factors. Simply increasing electricity supply may not produce the expected poverty-reduction effect if households lack productive assets, employment opportunities, skills, or access to financial resources. Therefore, electricity investment should be integrated with employment promotion, entrepreneurship development, and support for productive investment. The regression results for sewerage services show a negative relationship with poverty, represented by $B = -0.00045$ and $R^2 = 0.22$. Compared with electricity and housing, the explanatory power of sewerage services is

relatively low.

Nevertheless, the negative coefficient has an important socio-economic interpretation because sanitation infrastructure affects household welfare through health, environmental quality, and living conditions. Improved sewerage services can reduce exposure to sanitation-related health risks and contribute to a healthier living environment. For low-income households, better sanitation may indirectly reduce medical expenditures and the loss of working time associated with illness. Healthier household members are also more capable of participating consistently in education and employment activities. Consequently, the poverty-reduction mechanism of sanitation infrastructure is not necessarily immediate; rather, it can operate through health improvement, productivity growth, and lower household vulnerability. The relatively low R^2 value indicates that sewerage services alone cannot explain a substantial proportion of poverty variation. This finding is economically reasonable because poverty is determined by a broad range of factors, including income, employment, education, household size, prices, access to financial resources, and economic activity. Nevertheless, sanitation infrastructure remains an important complementary factor in regional poverty-reduction policy. The strongest relationship among the analyzed infrastructure indicators was identified between housing provision and poverty, with $B = -4.82$ and $R^2 = 0.71$.

This result is particularly important because housing represents not only a basic social necessity but also an important component of household economic security. The high R^2 value indicates that housing provision explains a relatively large share of the variation in the poverty rate within the analyzed dataset. The negative coefficient suggests that improvements in housing provision are associated with reductions in poverty. Adequate housing can improve living standards, reduce vulnerability to environmental risks, and provide households with greater social and economic stability. Housing conditions also influence the distribution of household expenditure. When households have access to adequate and affordable housing, the proportion of income allocated to emergency repairs, temporary accommodation, overcrowding-related costs, and other housing-related burdens may decline. This can increase the resources available for food, education, healthcare, and productive consumption. At the regional level, housing construction can additionally generate employment through construction activities and related industries.

This creates a dual effect: households benefit from improved housing conditions, while the construction sector generates demand for labor, materials, transport, and related services. Thus, housing investment can contribute simultaneously to social welfare improvement and local economic activity. Taken together, the empirical findings demonstrate that infrastructure development should be considered an important component of a broader poverty-reduction mechanism in Kashkadarya Region. The negative relationships observed for electricity supply, sewerage services, and housing provision indicate that improvements in basic infrastructure can contribute to better household welfare and lower poverty. At the same time, the positive association between drinking-water access and poverty demonstrates that the relationship between infrastructure expansion and poverty is not always linear or immediate. The results therefore support an integrated infrastructure-investment approach. Such an approach should combine physical infrastructure development with measures aimed at increasing household income, expanding employment opportunities, improving access to education and healthcare, and supporting entrepreneurial activity.

The poverty-reducing effect of infrastructure is likely to be stronger when infrastructure investments are concentrated in economically vulnerable territories and coordinated with local development programs. An additional implication concerns the quality and spatial targeting of investment. Regional investment policy should not rely solely on aggregate infrastructure indicators. It should identify territories where infrastructure deficits overlap with high poverty concentrations. This would allow public and private investment resources to be directed toward projects with the greatest potential social return. Overall, the findings confirm that infrastructure represents an important channel through which regional investment can influence poverty dynamics. Housing provision has the strongest observed negative relationship with poverty ($R^2 = 0.71$), followed by electricity supply ($R^2 = 0.65$) and sewerage services ($R^2 = 0.22$). The drinking-water indicator requires

a more nuanced interpretation because its positive association may reflect territorial and demographic characteristics rather than a direct poverty-generating effect.

Therefore, poverty reduction in Kashkadarya Region should be pursued through a differentiated investment strategy that considers infrastructure type, territorial vulnerability, service quality, affordability, and household access. The principal policy implication is that investment attraction should increasingly focus on projects capable of generating both social and economic returns. Investments in housing, energy, sanitation, and basic services should be linked with employment creation and income-generating opportunities. Such coordination can strengthen the transformation of infrastructure investment into sustainable improvements in household welfare and contribute to a more inclusive model of regional economic development.

CONCLUSION

The study examined the relationship between infrastructure development and poverty reduction in Kashkadarya Region during 2010–2025. The findings demonstrate that infrastructure investment represents an important factor influencing regional poverty dynamics, although its effects differ depending on the type and accessibility of infrastructure. The strongest negative relationship was identified for housing provision ($B = -4.82$; $R^2 = 0.71$), followed by electricity supply ($B = -0.40$; $R^2 = 0.65$). Sewerage services also demonstrated a negative relationship with poverty ($B = -0.00045$; $R^2 = 0.22$). These results indicate that improving basic living conditions and infrastructure accessibility can contribute to sustainable poverty reduction. The positive relationship between drinking-water access and poverty ($B = +0.24$; $R^2 = 0.63$) requires a differentiated interpretation, as it may reflect territorial, demographic, and distributional characteristics rather than a direct poverty-increasing effect.

Therefore, infrastructure policy should focus not only on expanding coverage but also on improving service quality, affordability, reliability, and equitable territorial distribution. Overall, the results support an integrated regional investment approach in which infrastructure modernization is combined with employment creation, income growth, and targeted support for vulnerable households. Such an approach can strengthen the socio-economic impact of investment and create more sustainable conditions for poverty reduction in Kashkadarya Region.

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