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# Factors Analysis Affecting The Efficiency of Ecological Tourism (Case in Uzbekistan)

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**Abstract:** This article identifies the factors affecting the efficiency of national parks where ecological tourism is organized. In order to determine these factors activity statistics of 12 national parks of Uzbekistan were obtained. As influencing factors the budget funds allocated to park maintenance, the amount of biological resources, the zone allocated for recreation, the area of the protected part of the park, employee numbers and scientific staff were chosen. Correlation and regression models were adopted to determine the level of influence of the above factors. State budget funds and the level of qualified personnel with extensive experience in the field were found as positive effects.

**Keywords:** National Parks, Protected Areas, Natural Resources, Economic-Mathematical Models Correlation, Regression

## 1. Introduction

Analyzing the effectiveness of ecotourism, several factors should be determined as they can have high impact on the income from the use of natural resources and ecotourism resources in specially protected areas used for tourism purposes in our country. To increase the efficiency of ecological tourism, to attract highly qualified scientific personnel, to ensure the optimal balance of budgetary and extra-budgetary funds that help to rationally use specially protected areas for tourism purposes by implementing effective biotechnical measures to preserve and restore unique flora and fauna. More attention is needed. Improving the efficiency of ecotourism creates reserves that increase the capacity of ecotourism areas for its sustainable development. Improving the effectiveness of national parks used in ecotourism involves the development and implementation of economic-mathematical models that take into account the influence of development factors. Ecotourism activities of organizations represent the ability to provide services to tourists visiting areas with special natural resources and climatic conditions, while maintaining biodiversity and complying with capacity standards. Factors to increase the efficiency of economic activity of national parks:

a. Budget funds for the maintenance of the national park;
b. Availability of biological resources and changes in their quantity (objects of flora and fauna);
c. Scientific staff;
d. Area of the recreational area of the National Park;
e. The territory of the protected area of the park;
f. Extra-budgetary funds for the maintenance of the national park;

g.   Number of visitors to the national park.

**Literature Review**

Preservation of natural resources is one of the most important tasks in protected areas. It will be necessary to increase the importance of ecotourism in the preservation of such resources and determine the factors in its development. Of course, in such a situation, it is necessary to take into account the requirements of stability [10]. Economic, cultural, political aspects of ecotourism determine the scope of influence of various factors [9]. Sustainable development of ecological tourism depends on socio-geographical inquiries and the creation of special infrastructure by local authorities [11]. Such infrastructures include local culture, government commitments, services and physical facilities [2]. Neglecting any aspect in the development of ecotourism can cause various environmental problems. In the process of development it is necessary to figure out ecotourism effecting factors. The aspect of naturalness includes the climate, landscape and nature of the tourist area[5]. Long-term development is achieved by keeping the environment clean [6]. The government's decisions on the industry are also factors that promote tourism [1]. In this, along with social and cultural programs the government's economic plans are also important[3]. The state's attention to the area will lead to the image of the protected area, the satisfaction of tourists and the sustainable development of ecotourism [8]. Moreover, the involvement of local people in the field working as personnel in the field [4],[7] is one of the requirements of ecotourism.

Strategic development of service industry enterprises implies constant adjustment of the purpose and strategic development of the enterprise in accordance with market demand[12]. According to the results of the implementation of the strategic business plan, proposals for its effective implementation are developed. In order to analyze the problems of improving the efficiency of national parks, it is necessary to study the factors comprehensively by developing models[13]. Traditional statistical methods (grouping, absolute and relative values) were used in the analysis of ecotourism development, but these methods do not allow determining influence level of factors on increasing efficiency. Econometric methods accept both theoretical analysis with mathematical analysis to determine a relationship between those factors and their influence degree on innovative activity[14].

Identifying all unexplored factors and determining the efficiency of their targeted use is an important element of strategic development programs of ecotourism, planning budget funds for the maintenance of national parks[15], developing estimates, and forming the scale of intervention in the activities of national parks. Econometric methods of analysis can develop high opportunity for analyzing connections between variables, determining the laws of socio-economic issues, and for empirical observation.
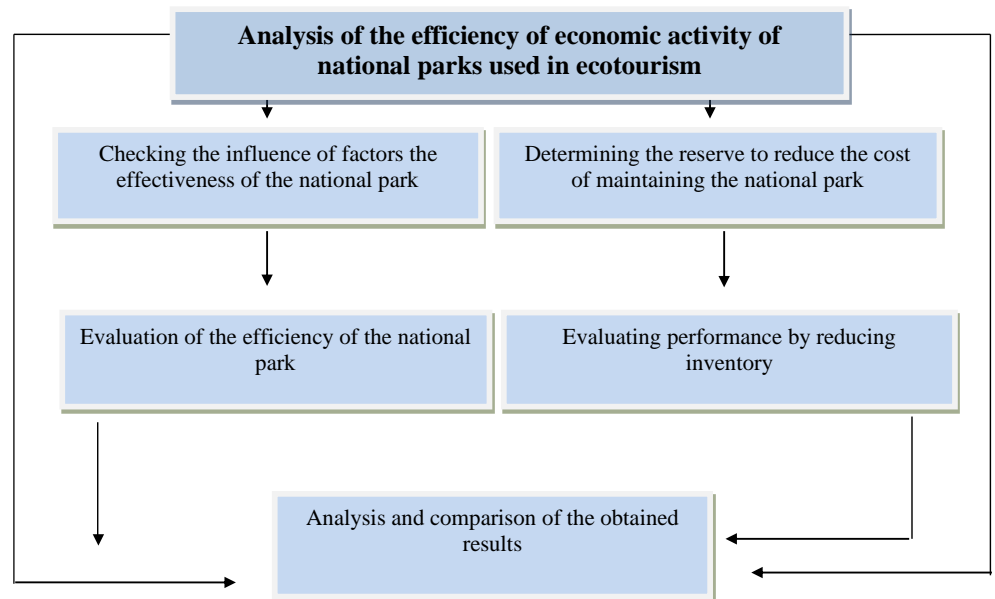
**Figure1.** Implementation of priority changes in the algorithm for analyzing the efficiency of economic activity of national parks.

During the implementation of plans, corrections are made and constantly monitored. At this point, it is necessary to strengthen mutual cooperation with organizations that provide commercial and financial services. The development of new methods of problems that may arise at the planning stage, the development of strategic measures for improving the qualifications of personnel are important in the development of ecological tourism.

## 2. Materials and Methods

This The methodology employed in this study focuses on identifying and analyzing the factors influencing the efficiency of ecological tourism in Uzbekistan's national parks. Data were gathered from documentary sources, including reports, bulletins, and official documents pertaining to the activities of 12 national parks. The dataset encompassed variables such as visitor statistics, total land area, budget allocation, biological resources, number of employees, and scientific staff. To examine the relationships between these variables and their impact on ecotourism efficiency, a correlation-regression analysis was conducted. The regression model was designed to establish the multifactorial relationship between revenue generated from ecotourism services and selected independent variables, including budgetary funds, biological resources, scientific personnel, recreational area size, and protected area size.

The statistical analysis involved determining coefficients of correlation and regression, assessing the significance of individual factors, and forecasting future trends using the developed econometric model. Key metrics such as the multiple correlation coefficient (R) and coefficient of determination (R²) were used to evaluate the model's reliability. Additionally, the analysis accounted for fixed and operational costs associated with park management, offering insights into revenue patterns and identifying areas for optimization. The model's validity was verified through rigorous mathematical and statistical tests to ensure robustness.

This approach not only facilitated the identification of factors critical to improving ecotourism efficiency but also provided a predictive framework to inform policy decisions. By integrating quantitative analysis with strategic planning, the methodology ensures a

comprehensive understanding of the variables shaping the ecological tourism landscape in Uzbekistan.

### 3. Results

The task is to find an analytical expression that shows how the value of Y depends on the value of the income from the sale of ecotourism services on the values of the factors $x_1$, $x_2$,....$x_n$. In our study, these are the national park budget, the number of biological resources, the area of the recreation area, the area of the protected area, the number of staff and the number of researchers.

It is necessary to find the relation $Y = f(x_1, x_2,...x_n)$. For this the method of correlation-regression analysis should be used.

**Table 1.** Results of multivariate regression analysis.

| T/r | Result | P.n. |
|---|---|---|
| 1. | Constanta, permanent member | A |
| 2. | Multiple correlation coefficient | R |
| 3. | Regression coefficients | $b_1$, $b_2$,... $b_k$ |
| 4. | Forecasting errors | Y |
| 5. | Standard error of the estimate | Se or S |
| 6. | Determination coefficient | R squared |
| 7. | F-test | Important or unimportant |
| 8. | t-tests for individual regression coefficients | Significant or insignificant for each X variable |
| 9. | Standard errors of regression coefficients | $S_{b1}$, $S_{b2}$, ....$S_{bk}$, |
| 10. | Number of degrees of freedom | n-k-1 |

The most common and studied equations for predicting parameters are:

Linear equation – $Y = a + b_1 x_1 + b_2 x_2 + ....+b_n x_n$;

Parabolic equation - $Y = a + b x + c x^2$;

Hyperbolic equation - $Y = a + b/x$;

Logarithmic - $Y = a + b_1 \ln x_1 + b_2 \ln x_2 +.....+ b_n \ln x_n$;

Power – $Y = a x_1^{b1} x_2^{b2}...x_n^{bn}$.

In the study of the relationship between national park income and factors, we use the linear form of multifactor relationships not only as a mathematical basis, but also as a form provided by software products. In order to determine the factors affecting the efficiency of national parks, we selected 12 national parks serving tourists (Appendix 1). Many factors affect the effectiveness of national parks.

During the monitoring, 6 main factors were identified: parks, biological resources (objects of flora and fauna), qualified scientific personnel, the area of the recreation area, the amount of budget funds for the maintenance of the area of recreation centers, the protected area and the total number of employees the number.

**Table 2.** Data sets for correlation and regression analysis of national parks performance.

| Service income (thousand soums) | Funds allocated from the budget | Bioresource (flora and fauna) | Scientific staff | Recreation area | Protective area | Number of employees |
|---|---|---|---|---|---|---|
| 11000 | 515125 | 850 | 1 | 3000 | 8000 | 29 |
| 915 375 | 1795280 | 158 | 4 | 69515 | 934584 | 38 |
| 1 246 320 | 1273675 | 326 | 6 | 352 | 1772 | 38 |
| 3 861 523 | 1945291 | 1282 | 1 | 8025 | 15516 | 70 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 019 005 | 680717 | 76 | 4 | 20000 | 74205 | 42 |
| 4 703 | 1200563 | 330 | 1 | 400 | 1000 | 15 |
| 209 408 | 1150612 | 187 | 2 | 448 | 2317 | 34 |
| 253 412 | 1169013 | 251 | 1 | 200000 | 700000 | 44 |
| 6 253 | 6097502 | 300 | 2 | 100000 | 400000 | 101 |
| 955 984 | 1132387 | 422 | 2 | 5500 | 10180 | 38 |

**Table 3.** Factors affecting the effectiveness of the national parks of Uzbekistan.

| No | Factors | Symbols |
|---|---|---|
| 1 | Sale of services to national parks, thousand soums | Y |
| 2 | Budget funds for park maintenance | $x1$ |
| 3 | Amount of biological resources, units. | $x2$ |
| 4 | Number of scientific staff, people | $x3$ |
| 5 | The area of the recreation zone, ha | $x4$ |
| 6 | The area of the protected area | $x5$ |
| 7 | Total number of employees | $x6$ |

Using the software, we obtained the results of the regression analysis of the data on the price of the tourist product (Appendix 3). A high R-value of 0.87 indicates a strong positive relationship between the identified factors, with the data clustered around a straight line pointing up and to the right (with little random scatter).

**Table 4.** Regression analysis results.

| Statistics | |
|---|---|
| Multiple regression coefficient R | 0,874839 |
| The coefficient of determination is R squared | 0,765343 |
| Normalized R squared | 0,296028 |
| The standard error of the Se estimate | 975547,3 |
| Observations | 10 |
| Correlation coefficient ryx1 | 0.80 |
| ryx2 correlation coefficient | 0.92 |
| ryx3 correlation coefficient | 0.98 |
| The correlation coefficient is rx1x2 | 0.82 |
| The correlation coefficient is rx1x3 | 0.86 |
| The correlation coefficient is rx2x3 | 0.79 |

Determined factors account for 76.5% of the variability of revenues from the sale of national park services, and the remaining 23.5% are explained by the influence of other unknown factors. The standard error of the estimate Se = 7975547.3 shows the size of the difference between the actual volume and the estimated volume of sales revenue In our case, the regression equation looks like this

Y = 1312949+ 0.68 x1+1571, 5x2 +142319, 6x3+ 1.2 x4;

Fixed costs of national parks amount to 1 312 949 thousand sums, and the remaining costs correspond to operational costs. In our case, the fixed costs include the costs of maintaining the protected area, salaries of the administration and other administrative and management costs.

The results of the F test show that the model is significant. Regression coefficient b1= 0.68 to increase sales revenue by 32%, increase sales services by 55.6 thousand sums, increase the income of each additional flora and fauna object by 1571 thousand sums, hire scientific staff shows the need to increase. Income by 142,319 thousand sums, one hectare of recreation area increases the total income by 1.2 thousand sums.

The biggest positive impact is related to the amount of biological resources in the territory of the national park, the availability of scientists, and the expansion of the recreation zone with the reduction of budget funds. We can be 95% sure that spending on biological resources will increase revenue from the sale of national parks. It is necessary to increase the number of higher educational institutions training specialists in biodiversity conservation, which will allow to increase the number of objects of the flora and fauna, and to improve the relevant legal framework regulating PPP in the field of ecotourism in the republic. This leads to a multiplier effect. The growth of the volume of sold services will be helped by the presence of a recreational zone that requires additional capital investments from investors and financial institutions.

## 4. Discussion

Thus, to determine the influence of factors on the volume of sold services, we developed the following multifactor model:

| No | Indicator | The type of equation | Model | Model type |
|---|---|---|---|---|
| 1 | Volume of services sold | $Y = a + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n;$ | $1312949 + 0.68\, x_1 + 1571,5x_2 + 142319,6x_3 + 1.2\, x_4;$ | Multivariable linear model |

The application of this model provides a scientific basis for the formation of a strategy for the development of ecotourism through the effective organization of the work of national parks. Fixed costs of the organization are an important reserve for financing innovative development.

Based on the above-mentioned trend regression models, we forecast each factor and put their values in the arguments of the model to determine forecast parameters for future periods:

**Table 5.** Forecast of the resulting indicator and related factors for future periods.

|  | Y(t) | x1 | x2 | x5 | x7 |
|---|---|---|---|---|---|
| 2014 | 0,36 | 62,1 | 2,9 | 17 | 119 |
| 2015 | 0,4 | 76,4 | 3,0 | 20 | 130 |
| 2016 | 0,5 | 83,7 | 3,2 | 26 | 154 |
| 2017 | 0,6 | 120,9 | 3,5 | 34 | 187 |
| 2018 | 1,3 | 183,2 | 4,1 | 42 | 210 |
| 2019 | 2,4 | 199,8 | 4,7 | 93 | 241 |
| 2020 | 0,3 | 240,3 | 5,6 | 119 | 83 |
| 2021 | 0,9 | 263,7 | 6,2 | 170 | 286 |
| 2022 | 2,5 | 355,4 | 7,1 | 231 | 554 |
| 2023 | 3,1 | 1223,0 | 7,9 | 256 | 703 |
| 2024 | 2,6 | 736,7 | 8 | 256 | 553 |
| 2025 | 2,9 | 819,6 | 8,6 | 284 | 606 |
| 2026 | 3,1 | 902,5 | 9,2 | 312 | 658 |
| 2027 | 3,4 | 985,4 | 9,7 | 341 | 710 |

| 2028 | 3,6 | 1068,2 | 10,3 | 369 | 762 |
|------|-----|--------|------|-----|-----|

With the help of these forecast indicators, the development of tourism services, regional development programs and concepts, and specific directions of measures to be implemented will be determined. Accordingly, forecast indicators should include accuracy, validity, multifactoriality and verification. The results of the calculations carried out during the research show that during the forecast period (2023-2028), the export of tourist services is expected to increase by 16.1% (Table 5). The volume of investments in the tourism sector is 0.9%, the share of investments in the tourism sector in the gross investments is 30.4%, the number of accommodation facilities is 44.1%, the loading coefficient of the number fund in hotels and accommodation facilities will increase by 8.3%.

## 5. Conclusion

The study highlights that the efficiency of ecological tourism in Uzbekistan's national parks is significantly influenced by factors such as allocated budgetary funds, biological resources, scientific staff, and the area dedicated to recreation. Using a robust econometric model, the research demonstrates a strong correlation (R=0.87) between these variables and the revenue generated from tourism services. The findings underscore the need for increased investment in biodiversity conservation, development of ecotourism infrastructure, and enhancement of legal frameworks to support public-private partnerships. Implications of this study suggest that targeted interventions in these areas could amplify the economic and ecological benefits of tourism. Further research should focus on integrating socio-cultural factors and exploring innovative funding mechanisms to ensure sustainable development of ecological tourism.

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