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Article

Prospects of Agrotourism Development in the Region

Bahodirhon Safarov [1], Akmal Amirov [2], Nargiza Mansurova [3], Thowayeb H. Hassan [4], Habibullo Hasanov [5,6,*], Ana Cornelia Pereș [7,*], Bahadur Bilalov [8] and Khasan Turdibekov [5]

1 Department of Digital Economics and Information Technologies, Samarkand Branch of Tashkent State University of Economics, Samarkand 140147, Uzbekistan; safarovb@rambler.ru
2 Department of Network Economics, Institute of Human Resources and Neighborhood Development Management, Samarkand State University Named after Sh. Rashidov, Samarkand 140105, Uzbekistan; amirovakmal75@gmail.com
3 Scientific Research Department, "Silk Road" International University of Tourism and Cultural Heritage, Samarkand 140104, Uzbekistan; n.sh.mansurova@gmail.com
4 Social Studies Department, College of Arts, King Faisal University, Al Ahsa 31982, Saudi Arabia; thassan@kfu.edu.sa
5 Department of Green Economy and Sustainable Business, Samarkand Branch of Tashkent State University of Economics, Samarkand 140147, Uzbekistan; khasant2014@gmail.com
6 Department of Real Economy, Samarkand Institute of Economics and Service, Samarkand 140100, Uzbekistan
7 Department of Environmental Engineering, Faculty of Environmental Protection, University of Oradea, 410087 Oradea, Romania
8 Department of Tourism Business, Azerbaijan Tourism and Management University, Baku 1172, Azerbaijan; b.bilalov@atmu.edu.az
* Correspondence: khabibulloeco@gmail.com or hasanov_habibullo@sbtsue.uz (H.H.); peresana35@yahoo.com (A.C.P.)

Abstract: For every nation, the era of transition to a market economy is marked by a severe lack of financial resources. Bringing in sectors of the economy that yield the fastest and most efficient returns is one strategy to develop and overcome this issue. Agrotourism, which is seen as a new trend in the tourism business, is one of these industries. The Samarkand region is used as an example to examine the scientific and theoretical underpinnings of agrotourism as well as its geographical characteristics in this article. Furthermore, an agrotourism map of the region was created by evaluating each location's potential for agrotourism, classifying the regions based on how desirable they are for agrotourism, and identifying the facilities and resources available for agrotourism. Factors affecting the market of tourist services in the area were studied, and forecast values of the volume of tourist services were determined.

Keywords: tourism market; agrotourism; regional features of agrotourism; agrotourism potential; agrotourism attractiveness; agrotourism map; agrotourism cluster; agrotourism forecast

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1. Introduction

Humanity's socio-economic and ecological activities have caused many negative consequences for our planet, causing problems such as climate change, pollution, and biodiversity loss (Leal Filho et al. 2023). Sustainable development is not only a trend of growth but a necessity that covers all social and economic areas of our life, including tourism, that is, "a resource industry that depends on the natural and human potential of society, cultural heritage (Dorobantu and Nistoreanu 2012).

The large-scale extraction of natural resources, the acceleration of urbanization, and the development of industry are examples of the destabilization of the climate system and the tendency of unsustainable economic growth, which demanded new discussions about the need for more viable development models. In turn, this gradually led to the emergence of the agritourism model, one of the business models attracting the interest of farmers and other types of enterprises (Al Abri et al. 2023). Agrotourism is gradually emerging as a

unique form of leisure activity in the set of options available to tourists when choosing tourist destinations (Rozier Rich et al. 2016).

Agrotourism is an activity that links the economic, social, and environmental components of sustainability, closely related to local communities and their attitudes toward tourism (Muresan et al. 2016). Agrotourism is becoming increasingly popular today, with competitive entrepreneurs turning farmers into profitable businesses and protecting it from market fluctuations (Chiang et al. 2017).

Furthermore, the quality of the air (Ilieș et al. 2022) and the preservation of traditional items (Marcu et al. 2020; Wendt et al. 2021) in agrotourism facilities situated at a considerable distance from urban areas are crucial factors in ensuring the health of tourists and enhancing their cultural and ecological experience. Agrotourism plays an instrumental role in safeguarding the way of life in rural areas and fostering economic growth in these communities. It ensures a harmonious coexistence between humans and the natural environment. Furthermore, preserving traditional technologies and cultural heritage enhances the sustainability impact of this form of tourism, which is a crucial aspect in addressing global environmental challenges.

The rapid development of the agrotourism sector in the world tourism market allows for an increase in the well-being and standard of living of the population in rural areas and the development of the socio-economic infrastructure. From this point of view, the study of regional features and perspective directions of organizational and economic development of agrotourism in Uzbekistan today is urgently important. Much scientific research has aimed to determine the demand and supply of agrotourism services, classifying the principles, factors, and stages of agrotourism development, and researching agrotourism development models are being carried out based on experiences in the effective development of agrotourism in the world. Therefore, it is important to research scientific problems such as evaluating the efficiency of agrotourism enterprises, forming agrotourism infrastructure, improving the quality and competitiveness of services in the field, and improving the methods of agrotourism potential assessment.

Today, in Uzbekistan, special attention is paid to improving the quality and competitiveness of agrotourism services, which are considered to be an important factor in the full and effective use of agrotourism potential. To solve these tasks, it is urgent to deepen scientific research in areas such as assessing the level of agrotourism potential, forming the agrotourism image of regions, and improving the regional agrotourism development model.

Our research will greatly contribute to the economic and social growth of rural areas. It will create new opportunities for local people while preserving the region's natural resources and cultural heritage. Innovative technologies and cooperation networks can achieve sustainable agrotourism development. The results of these studies are important for improving regional policy and promoting agrotourism at the international level.

2. Literature Review

In several European countries as well as the United States, farm and ranch stays are still very popular. The 1985 National Legal Framework for Agritourism in Italy is most likely when the term "agritourism" first appeared in the United States. This statute supports agriturismo, or overnight farm stays, as a means for Italian farmers to generate additional revenue to sustain their agricultural buildings, landscapes, and farming methods. In Tuscany, Italy, and many other locations where gastronomic tourism and agritourism go hand in hand, agriturismo is growing in popularity. The main focus of agritourism in several parts of the world is the production of particular foods and beverages. Traditional specialties guaranteed (TSG), protected geographical indication (PGI), and protected designation of origin (PDO) are all found in Europe (Chase et al. 2018).

Research on agritourism is a challenging subject. It can be viewed as a fringe practice that offers a range of goods and services, setting it apart from conventional rural tourism and forming a new category of industrial tourism. It is a diversified and agriculture-

based development pattern that blends agricultural production with unique forms of tourism. Communities can "revitalize rural economies, educate the public about agriculture, and preserve agricultural heritage" by means of agritourism, or as the USDA puts it, "agricultural tourism or recreational services" (USDA 2024).

The definition of a farm has received little attention in the literature on agritourism, and when a working farm is mentioned as a prerequisite for agritourism, it is sometimes not defined at all. This presents a significant issue in the context of the larger discussion surrounding rural areas because the "farm" might be interpreted in terms of its social and cultural significance in addition to its economic value (Burton 2004).

While agrotourism seems to be booming in actuality, opinions on its conceptual parameters and features disagree, which causes ambiguity in the definitions and categorizations of this new phenomenon. Furthermore, these definitions' inconsistent nature and the absence of a consensus framework in pertinent research, legislation, and initiatives remain a barrier (Roman and Grudzień 2021).

Sometimes, the terms rural tourism and agritourism are used interchangeably, with rural tourism being a broader spatial term (Karampela et al. 2019b). As the terms "working farm" and agritourism are more commonly used in North American and European studies, it can be argued that the consensus is still evolving (Phillip et al. 2010).

Agrotourism, rural tourism, and ecotourism, while interconnected, differ in focus, objectives, and practices. Agrotourism centers on agricultural activities, offering tourists the opportunity to engage in farm-based experiences like crop harvesting, animal husbandry, and local culinary traditions. It directly supports agricultural sustainability and rural economic revitalization by attracting income to farm communities (Milojević et al. 2024). Rural tourism, broader in scope, encompasses cultural immersion in rural settings, including traditions, local crafts, and village life, with an emphasis on social and infrastructural development. Ecotourism, distinctively, focuses on nature-based experiences promoting conservation and environmental sustainability, often intersecting with biodiversity protection and minimizing ecological impact (Phukan et al. 2024).

While agrotourism provides economic benefits through activities tied directly to farming, rural tourism enhances broader social engagement, fostering cultural exchange and heritage preservation (Esitti 2023). Ecotourism, meanwhile, appeals to environmentally conscious travelers, emphasizing minimal environmental disruption and conservation of natural areas. Integrative approaches combining aspects of these tourism types can create synergistic opportunities, such as organic agricultural tourism that caters to both cultural and ecological sustainability (Hazuda et al. 2023).

French researcher F. Moinet gave a general definition of agrotourism in his work "Rural Tourism". According to the concept of F. Moinet, "agritourism is a unique form of tourist recreation in rural areas, related to the active participation of tourists not only in rural life but also in agricultural production" (Moinet 2006). M. Jensen-Verbeke states, "Rural tourism and agritourism, like every economic activity, seeks to offer and provide products and/or services. The rural and agrotourism product is complex, and its simple definition is reflected in the description of its structural elements" (Jansen-Verbeke 1990).

Wiatrak says that "a rural or agrotourism product can be characterized as a separate product or set of products that is determined by nature, history, and human activity and is demanded by tourists" (Wiatrak 1998). In his scientific research, T. Streifeder states that "agritourism and other types of tourism in rural areas are specific concepts of being a guest in rural tourism, which are significant depending on the authenticity of the offered tourist product and the level of participation in agricultural life differs in degree" (Streifeneder 2016). According to Gladstone et al., "a working farm is a key feature of agritourism, and tourism is an additional source of income for them" (Gladstone and Morris 2000). Arroyo et al., in a study conducted in North Carolina regions, defined agritourism as "agricultural activities conducted for recreational or educational purposes on an operating farm or other agricultural enterprise" (Gil Arroyo et al. 2013).

In his research, N. Srisomyong defines agrotourism as follows: "agrotourism is a type of farm diversification that can be developed as a supplement to agriculture. It provides an additional secondary occupation to the rural population and it employs a small amount of money" (Srisomyong 2010). Taiwanese experts N. Kuo and Y. Chiu reported in their observations: "The symbiotic relationship between tourism and agriculture (mutually beneficial relationship between sectors) found in agritourism is an important element of environmentally and socially responsible tourism in rural areas. Rural hospitality offers new jobs and income opportunities for rural residents. Also, cultural exchange with agricultural methods, artistic heritage, handicrafts, and culinary traditions are directly expressed in agrotourism" (Kuo and Chiu 2006).

Authors of the article "*Provision of public and private interests through different directions of agritourism*" S. Flanigan, K. Blackstock, and S. Hunter mentioned "In agritourism, agriculture becomes a place of exchange of "currency", as a result of which visitors can exchange their tourism experience in exchange, they make a physical contribution to the development of agriculture" (Flanigan et al. 2015). S. Phillip, K. Hunter, and K. Blackstock have developed a theoretical classification of agrotourism processes based on the following three criteria: availability of conditions in the operating farm; the degree of contact between tourism and agricultural activities (i.e., passive, direct, or indirect); and authenticity or superficiality of the visitor experience. Based on these three criteria, they propose a non-hierarchical five-class typology of agritourism: (1) non-working farm agritourism, such as former farm bed and breakfast; (2) agrotourism with passive engagement, such as bed and breakfast on an operating farm; (3) agrotourism, which is indirectly related to working on the farm, is carried out, for example, by delivery of agricultural products during meals on the farm; (4) step-by-step agritourism in the form of direct contact with farm activities, for example, watching demonstrations of agricultural processes; and (5) authentic agritourism, such as full participation and assistance in farm operations (Phillip et al. 2010).

Also, we offer the definitions of "agrotourism" as provided by both international and local specialists (Table 1).

Table 1. Definitions of agrotourism given by the authors.

Authors	Definitions
Weaver and Fennell (1997)	The practice of agricultural businesses promoting tourism in their areas is known as agrotourism. The first type of sustainable tourism is agrotourism.
Nickerson et al. (2001)	Agritourism as "a commercial enterprise at a working farm, ranch, or agricultural plant conducted for the enjoyment or education of visitors".
Roberts et al. (2001)	Agritourism as "a subset of rural tourism that allows visitors to engage in farm-related activities, often in combination with accommodation in rural settings".
McGehee and Kim (2004)	Agritourism is the act of visiting a working farm or agricultural, horticultural, or agribusiness processes for enjoyment, education, or active participation in farm activities or processes.
Graciá-Carpio et al. (2008)	Agritourism as "the practice of attracting visitors to farm areas for the purpose of experiencing aspects of agricultural life, including farm stays, tours, and hands-on experiences."
Olsen (2009)	Agritourism as "a form of tourism which links agricultural production or processing with tourism in such a way that the tourist is given the opportunity to learn about farming and rural life."
Forbord et al. (2012)	Agrotourism encompasses lodging for visitors, eating and drinking locally produced food and beverages, experiencing rural customs, and engaging in recreational, educational, and artistic pursuits.
Tew and Barbieri (2012)	Agrotourism is a type of rural tourism that includes any activity carried out on farms and agricultural operations.
Flanigan et al. (2014)	Agrotourism is the practice of bringing tourists to farms for leisure and education about farming life.
Viglia and Abrate (2017)	While it is a subset of rural tourism, agrotourism varies in the extent to which it incorporates agricultural activities.

Thus, it is possible to discriminate between the following traits using the definitions provided. First, without the use of artificial processes, agrotourism promotes sustainable development. Second, it makes it possible to use the variety of the country and the region in the tourism services market to create a new eco-friendly tourism product. Thirdly, the villagers can get additional financial advantages from the sale of agrotourism goods, which can potentially serve as their primary source of income. Fourth, it illustrates how the population in rural areas is becoming more employed, educated, and socially adapted. Fifth, agrotourism is a form of travel where visitors actively engage in the process, such as helping to grow, tend, and harvest crops and prepare meals. This kind of tourism is characterized by this feature. Agrotourism is a combination of ecotourism, active tourism, cultural and educational tourism, and nature tourism. It should be noted that the term "agrotourism" does not adequately capture what it means when one of these foundational forms of tourism is absent.

The Samarkand region, with its rich historical heritage and natural resources, has great potential for agrotourism. However, to achieve high results in the development of agritourism, studying international experience, in particular, using successful models of countries such as Italy and Greece, can be an effective way. The development of agritourism in Italy and Greece showcases distinct models influenced by cultural, economic, and environmental factors. Both countries leverage agritourism to stimulate rural economies, yet their approaches differ significantly, reflecting their unique contexts. Agritourism in Italy emphasizes sustainable growth through the integration of agricultural resources and cultural heritage. The Calabria region exemplifies this, where agritourism activities are designed to revitalize rural communities and create a network of local farms (Ammirato and Felicetti 2013).

Agritourism in Italy and Greece presents distinct models shaped by regional characteristics and sustainability goals. In Italy, particularly in Tuscany and Apulia, agritourism integrates local food production with tourism, emphasizing environmental sustainability and territorial identity. This model promotes certified quality agricultural practices, allowing tourists to engage with local lifestyles and sustainable practices (Antolini and Truglia 2023).

Conversely, Greece's agritourism, exemplified by Nymfaio in Florina, focuses on preserving traditional settlements while providing economic opportunities for locals. This model has evolved over decades, catering to urban visitors seeking relaxation and rural experiences (Boulouta and Karagiannis 2022).

Italy's Agritourism Model. Italy's agritourism emphasizes sustainability, with a strong focus on ecotourism and local food production. Regions like Tuscany and Apulia serve as prime examples of successful integration between agriculture and tourism. These areas provide tourists with immersive experiences, allowing them to engage in local lifestyles and sustainable practices.

Greece's Agritourism Model. Greece's agritourism centers around preserving cultural heritage, particularly through maintaining traditional settlements and rural customs. It offers economic opportunities by generating income for local communities while attracting urban tourists. Regional diversity is notable, with areas such as Messenia and Nymfaio showcasing unique agritourism characteristics and challenges (Chronopoulou 2013; Karampela et al. 2019a). Additionally, activities like vacationing in country houses and visiting agritourism sites near the sea are highly developed.

In the Samarkand region, the above achievements of Italy and Greece can be used in the following directions:

1. Promotion of local culture and cuisine: Agritourism can be developed in rural areas in Samarkand in hotels based on specific cuisines and national traditions. For example, showing guests the process of making Samarkand bread and pilaf provides a unique experience. This can increase interest in national food products, as in Italy.

2. Demonstration of production and cultivation of products: As wine-making and fruit–vegetable cultivation are developed in Samarkand, demonstration of these processes to tourists can be organized. Inspired by tours of wineries in Italy and olive groves in

Greece, Samarkand can create a delightful experience for guests by showcasing local wine and dried fruit production processes.

3. Branding and export of agricultural products: Samarkand's unique agricultural products, such as grapes and pomegranates, can be introduced to the international market through branding. In this regard, the experience of the "agriturismo" brand in Italy can be used, and the promotion of agricultural products of Samarkand as "eco" or "organic" will further develop this sector.

4. Diversification and conducting seasonal events: Seasonal events related to grape and other fruit harvesting can be organized in the Samarkand region. These events allow tourists not only to participate in fruit picking but also to get to know village life. This type of experience can add to seasonal interest, such as the events surrounding the wine harvest in Italy and the olive harvest in Greece.

5. Development of agricultural infrastructure: To develop rural tourism in Samarkand, transport and infrastructure should be improved. For example, in Italy and Greece, local rural roads and transport systems have been adapted for easy access to agrotourism areas. In order to bring tourists to rural areas in Samarkand, it is necessary to develop modern and convenient infrastructure.

Based on the experience of Italy and Greece, it is possible to create attractive experiences for tourists by promoting national food and agricultural products and organizing seasonal events in rural areas, taking into account local opportunities in the development of agritourism in the Samarkand region. At the same time, the promotion of agrotourism at the international level by branding Samarkand's natural conditions and unique fruits and vegetables, especially grapes and pomegranate products in the international market, will open new opportunities for the Samarkand region.

3. Methodology

This article examines and scrutinizes scientific and theoretical approaches in accordance with the topic's scope. The chosen course was made in order to fulfill the research's objective. For the purpose of thoroughly examining and justifying primary and secondary data sources, a research plan has been established. This paper was written using a range of techniques and strategies, including qualitative research. The following techniques were applied: induction–deduction, systematic method, abstract–logical reasoning, econometric analysis, statistical and comparative analysis, and forecasting.

This study was conducted by domestic and international authors on the issues surrounding the development of theoretical, analytical, and methodological approaches to the estimation of tourism potential. It is described in multiple directions and is applied using a variety of techniques. As a result, a number of strategies, including value and point evaluations and quantitative and qualitative methods, emerged.

Forming evaluation stages and identifying the key indicators characterizing the development potential are important to ascertain the region's level of agrotourism potential.

Stage 1. Evaluation of the region's allure from the perspective of growing tourism. Naturally, the assertion that tourism can flourish anyplace in the globe is untrue. Prior to everything else, the area must be assessed from the perspective of developing tourism. This necessitates an examination of a number of characteristics, including the existence of notable historical sites in the region, the degree of abrasiveness of the climate and natural environment, the existence of transportation networks, and the region's favorable perception.

Stage 2. Evaluation of the area's overall infrastructure for tourists. This phase encompasses the evaluation of the development of tourism infrastructure. To do this, an analysis of the current infrastructure is required. The evaluation will include an analysis of the quality of the services provided, the growth of transportation infrastructure, the severity of the criminal situation, the potential for the creation of a tourism cluster in the area, etc.

Stage 3. Evaluation of the area's agrotourism infrastructure. The following factors are analyzed as part of the evaluation of the region's agrotourism infrastructure: the quantity of rental homes and guest houses for agrotourists; the length and quality of paved roads;

the presence of traditional crafts; the degree of population welfare; and the population's proficiency in foreign languages; and the area's crime rate.

Stage 4. Choose the areas that are most appealing from an agrotourism standpoint. Currently, evaluating the area's appeal from the perspective of agrotourism development is crucial. We propose utilizing the following indicators to evaluate the attractiveness: the degree of pollution of the environment, the density of villagers, the number of agricultural businesses, the distance from the regional center, and the quantity of visitors.

Stage 5. Choosing distinctive (exclusive) agrotourism resources relevant to a particular region. It is well established that originality or uniqueness contributes to a competitive edge. Agrotourism can be created in this location if there are sufficient tourism resources available, which when integrated will produce a viable agrotourism offering.

Stage 6. Formation and promotion (advertising, PR) of agrotourism types (products). As mentioned above, to effectively plan the development of agrotourism in the conditions of the market economy, it is necessary to comprehensively evaluate its possibilities. This directly depends on the local authorities, investors, and owners of tourist businesses in the development of regional tourism, and it requires determining the size of the real tourism potential, its changing trends, and its efficiency.

This assessment's primary goals are to identify the resources available for the growth of agrotourism in the area, evaluate the industry's potential, and estimate how economically viable it is to replicate its structural components (Safarov and Janzakov 2021). By taking into account the potential that already exists, the regional evaluation system makes it possible to identify the places that are most conducive to the growth of agrotourism, which will support the development of its attractive business models.

It is proposed to evaluate the development potential of agrotourism at the regional level based on the integrated method (Table 2). This approach makes it possible to compare all analyzed indicators. The proposed evaluation algorithm includes the following steps:

1. Selection of indicators of regional potential of agrotourism in the section of its components. When choosing indicators, it is necessary to exclude from them those that are not formalized and do not have sufficient differentiation ability. At the same time, it is necessary to take into account the available statistical data collected at the district level.

2. Analysis of indicator values in a cross-section of districts to determine extreme (highest or lowest) and average values. It should be said that the extreme values of some specific indicators (the level of agricultural land development, the density of public highways covered with asphalt, the provision of housing to the population), as a rule, limit the opportunities for the development of agrotourism. Therefore, it is suggested to use the average values of these indicators.

3. Calculation of private points of the *i*-th indicator of the potential of the *j*-th administrative region (district). In this case, the following formulas are used (Sobol 2018):

$$PRC_{ij} = \frac{P_{ij}}{P_{\max ij}}, \text{ or } PRC_{ij} = \frac{P_{\min\ ij}}{P_{ij}}, \quad (1)$$

where P_{ij}—value of indicator i for district j; $P_{\max ij}$—observed maximum value of indicator i for district j; and $P_{\min\ ij}$—observed minimum value of indicator i for district j.

4. Calculation of the integrated indicator of the level of development of agrotourism in the section of administrative (AIL_j) regions (districts). This is calculated as follows:

$$AIL_j = \sum_{j=1}^{m} PRC_{ij} * \beta_i \quad (2)$$

where the level of development of agrotourism and the value of its private potential is the weight coefficient of the *i*-indicator of the potential obtained based on the expert method, and $j = 1 \ldots m$—the number of regions. The weight coefficient (β) is determined by the method of expert evaluation.

Table 2. Indicators of assessment of agrotourism potential of regions.

Indicator (Acronym)	Indicator Name	Description	Unit of Measure	Data Source
A1	Consumer goods per capita	The average monetary value of consumer goods available per person	Thousand UZS	Statistics Agency
A2	Agricultural, forestry, and fishery products per capita	The value of agricultural, forestry, and fishery products produced per person	Thousand UZS	Statistics Agency
A3	Services per capita	The monetary value of services consumed per person	Thousand UZS	Statistics Agency
A4	Retail turnover per capita	Total retail sales value per person	Thousand UZS	Statistics Agency
A5	Fixed capital investment per capita	The amount of investment in long-term assets per person	Thousand UZS	Statistics Agency
A6	Level of environmental pollution	Total emissions generated in the district	Ton	Statistics Agency
A7	The population of the village	Total number of people residing in rural areas of the district	Thousand people	Statistics Agency
A8	The level of housing provision of the population	Average residential area available per person	Residential area per inhabitant, square meter	Statistics Agency
A9	Number of farms	Total number of officially registered farms in the district	Unity	Farmers' Association of Samarkand region
A10	Distance from the regional center	The distance between the district and the regional center	Kilometer	Statistics Agency
A11	Objects of material and cultural heritage	Total number of registered cultural and historical sites	Unity	Tourism Department of Samarkand region
A12	Cultivated lands	Total land area used for agricultural purposes	Hectare	Farmers' Association of Samarkand region
A13	Gardens	Total area of land covered by gardens	Hectare	Farmers' Association of Samarkand region
A14	Vineyards	Total area of land used for vineyards	Hectare	Farmers' Association of Samarkand region
A15	Forests	Total area of forested land in the district	Hectare	Farmers' Association of Samarkand region

Note: all indicators in the table are calculated based on annual data. The data sources provide yearly updates; UZS—the national currency of Uzbekistan (Uzbekistani sum), according to the ISO 4217 standard. Source: created by the authors.

In the evaluation of the potential of regional agrotourism, representatives with experience from the Association of Farmers, the Department of Economy, the Department of Tourism, and the Department of Ecology of the Samarkand region were selected as experts. The chosen experts are individuals with high knowledge and skills who have been working in agriculture, industry, tourism, and ecology for many years and are conducting scientific research in their fields.

In the course of the expert method, experts evaluate 15 selected indicators on a 10-point scale (Table 3) (Muskat et al. 2012).

$$V_i = \frac{\sum A_i}{\max A_i} - \text{auxiliary coefficient;} \quad (3)$$

$$\beta_i = \frac{V_i}{\sum V_i} - \text{weight factor} \quad (4)$$

Table 3. Expert assessment of determining the weight coefficient of indicators of agrotourism potential.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	Amount
Expert 1	6	7	6	6	9	9	5	7	9	9	6	8	10	9	9	
Expert 2	5	6	6	5	8	7	6	5	8	7	5	7	8	7	8	
Expert 3	6	7	5	4	9	8	4	6	7	8	6	6	7	8	9	
Expert 4	4	6	4	5	8	9	5	6	9	7	4	6	9	8	8	
Expert 5	5	5	6	5	9	8	4	5	8	8	5	7	10	8	8	
Amount	26	31	27	25	43	41	24	29	41	39	26	34	44	40	42	
V_i	0.59	0.70	0.61	0.57	0.98	0.93	0.55	0.66	0.93	0.89	0.59	0.77	1.00	0.91	0.95	11.64
β_i	0.051	0.061	0.053	0.049	0.084	0.080	0.047	0.057	0.080	0.076	0.051	0.066	0.086	0.078	0.082	1.00

Source: created by the authors based on expert evaluations.

5. Division of districts into types according to the size of the total potential of agrotourism development. Depending on the level of these types, it is proposed to divide into 3 groups: low level, medium level, and high level.

6. Determination of the main tasks for the development of regional agrotourism and comprehensive measures to achieve them. At this stage, the results of the assessment carried out in the previous stages are summarized, and the prospects for the development of agrotourism are determined, taking into account the specific characteristics, competitive advantages, and potential of specific regions.

The proposed integrated method guarantees a seamless connection between qualitative and quantitative approaches. The preliminary selection and assessment of indicators establish a foundation, while the incorporation of subjective insights through expert-weighted scoring provides a more nuanced understanding. The cross-validation of district classifications through different methods, including statistical and expert evaluations, serves to reinforce the robustness of the approach. Furthermore, the iterative structure of this methodology, which encompasses the selection of indicators and the identification of tasks, demonstrates its comprehensive nature. The integration of data-driven techniques with expert judgement ensures actionable insights, which in turn support regional policy development and strategic planning for agrotourism.

4. Results and Discussion

Thus, the proposed methodological tools for assessing the regional potential of agrotourism development will justify the determination of the specific characteristics of the conditions of activity in a specific area, as well as the comprehensive measures to increase the effectiveness of the potential of agrotourism development in the region.

Table 4 below presents the accounting books of the integrated assessment carried out according to the assessment algorithm.

At the end of the evaluation algorithm, integrated indices of 15 agrotourism potential indicators were developed. The agrotourism attractiveness of the districts of Samarkand region was divided into three groups according to the Sterdjes criterion (Table 5).

Based on the calculation results, the regions were classified into high, medium, and low-level areas according to the levels of agrotourism attractiveness. The Sturges formula was used to classify areas (5) and (6):

$$n = 1 + 3.322 \lg N; \quad (5)$$

$$h = \frac{R}{n}, \quad (6)$$

where n—number of classes (intervals); N—number of observations (data points); h—the width of each class (interval); and R—the range of the data, calculated as X_{max}—X_{min}, the difference between the maximum and minimum values.

Table 4. Integrated indices of agrotourism potential of Samarkand region districts.

	Bulungur	Jomboy	Ishtikhan	Kattakurgan	Narpay	Nurabad	Akdarya	Past Dargom	Pakhtachi	Payarik	Samarkand	Taylak	Urgut	Kushrabat
A1	0.028	0.051	0.016	0.013	0.021	0.017	0.023	0.017	0.010	0.010	0.048	0.036	0.034	0.003
A2	0.061	0.038	0.040	0.053	0.023	0.020	0.042	0.025	0.033	0.041	0.028	0.040	0.026	0.035
A3	0.028	0.053	0.029	0.031	0.032	0.026	0.044	0.035	0.031	0.029	0.050	0.043	0.025	0.031
A4	0.049	0.038	0.030	0.027	0.026	0.030	0.029	0.032	0.026	0.031	0.033	0.028	0.040	0.029
A5	0.030	0.051	0.030	0.014	0.015	0.037	0.076	0.020	0.045	0.022	0.057	0.049	0.031	0.084
A6	0.007	0.004	0.010	0.011	0.000	0.004	0.010	0.003	0.005	0.010	0.004	0.003	0.004	0.080
A7	0.023	0.021	0.029	0.035	0.024	0.021	0.015	0.042	0.018	0.028	0.038	0.028	0.047	0.019
A8	0.041	0.036	0.039	0.033	0.037	0.046	0.041	0.030	0.043	0.034	0.057	0.044	0.024	0.032
A9	0.058	0.042	0.043	0.053	0.019	0.042	0.020	0.048	0.018	0.080	0.040	0.030	0.057	0.025
A10	0.027	0.058	0.011	0.008	0.007	0.012	0.021	0.032	0.006	0.017	0.076	0.076	0.022	0.008
A11	0.009	0.016	0.020	0.024	0.050	0.017	0.017	0.019	0.039	0.024	0.033	0.051	0.048	0.014
A12	0.025	0.031	0.029	0.040	0.032	0.010	0.032	0.066	0.028	0.049	0.009	0.013	0.023	0.003
A13	0.086	0.061	0.020	0.016	0.018	0.065	0.039	0.051	0.022	0.017	0.058	0.016	0.016	0.005
A14	0.024	0.002	0.055	0.017	0.006	0.001	0.005	0.013	0.002	0.028	0.042	0.032	0.078	0.007
A15	0.066	0.071	0.022	0.040	0.015	0.082	0.052	0.021	0.017	0.010	0.017	0.013	0.082	0.008
Integral indicator	**0.562**	**0.573**	**0.423**	**0.415**	**0.325**	**0.430**	**0.466**	**0.454**	**0.343**	**0.430**	**0.590**	**0.502**	**0.557**	**0.383**

Source: calculated by the authors.

Table 5. Classification of districts of Samarkand region according to agrotourism attractiveness (2023).

The Level of Agrotourism Attractiveness	Benchmark Indicators	Districts
High level	0.502–0.590	Samarkand, Jambay, Bulungur, Urgut, Taylak
Middle level	0.414–0.501	Akdarya, Past Dargom, Nurabad, Payarik, Ishtikhan, Kattakurgan
Lower level	0.325–0.413	Kushrabat, Pakhtachi, Narpay

Source: calculated by the authors.

In addition to the evaluation based on the Sturges criterion, a K-means clustering analysis was performed using STATA 15 software to further verify the classification of districts in the Samarkand region based on their agrotourism potential. The K-means method grouped the districts into three clusters, which were consistent with the classifications obtained through the Sturges criterion. Table 6 and Figure 1 illustrate the distribution of districts within these clusters.

Table 6. K-means clustering results of districts in Samarkand region based on agrotourism potential (2023).

Districts	Integral Indicator	Cluster
Bulungur	0.562	**2**
Jomboy	0.573	**2**
Ishtikhan	0.423	**3**
Kattakurgan	0.415	**3**
Narpay	0.325	**1**
Nurabad	0.430	**3**
Akdarya	0.466	**3**
Past Dargom	0.454	**3**

Table 6. *Cont.*

Districts	Integral Indicator	Cluster
Pakhtachi	0.343	**1**
Payarik	0.430	**3**
Samarkand	0.590	**2**
Taylak	0.502	**2**
Urgut	0.557	**2**
Kushrabat	0.383	1

Source: calculated by the authors using STATA 15 software.

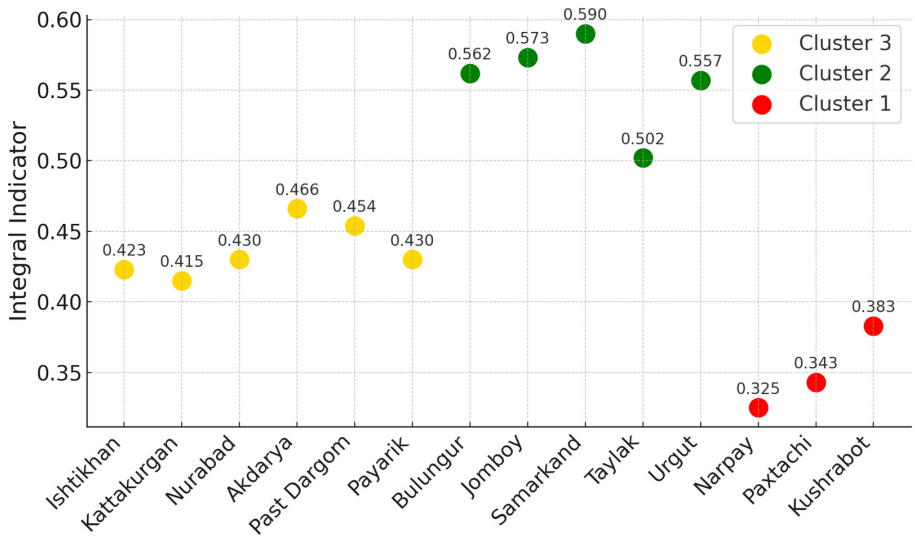

Figure 1. Scatter plot of integral indicators and clusters of agrotourism potential in Samarkand region. Source: created by the authors.

The average silhouette score for this clustering is 0.63, as shown in Figure 2, indicating a reasonably well-defined clustering structure. Silhouette analysis supports the quality of the clusters by demonstrating that the majority of districts are well grouped, as reflected in their positive silhouette coefficients.

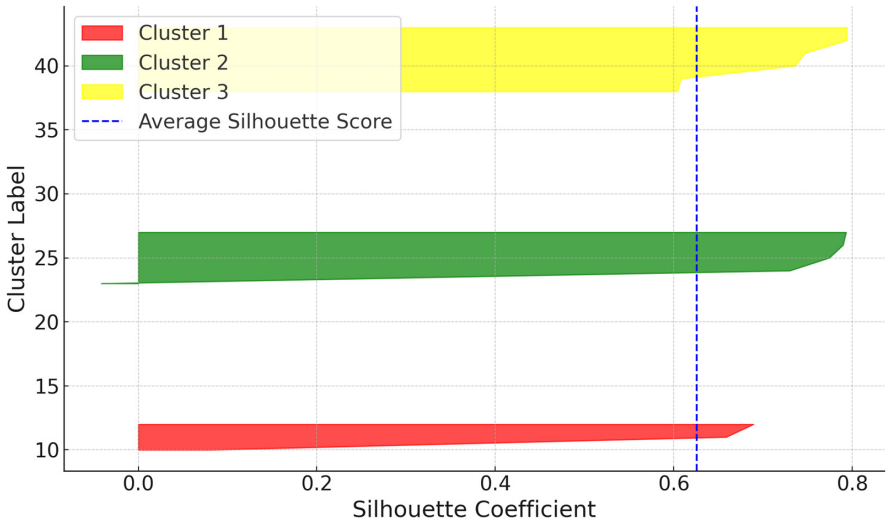

Figure 2. Silhouette analysis for K-means clustering of districts in Samarkand region. Source: created by the authors.

The comparative analysis between the Sturges and K-means methods confirms the robustness of the classification. Both methods consistently categorize the districts into high, medium, and low agrotourism potential, as detailed in Table 5. This consistency reinforces the validity of the evaluation model and enhances the reliability of the recommendations for policy and development strategies in the agrotourism sector.

Analyzing the results of Table 4, the integrated index of the Samarkand district has the maximum value (0.590) in the group with high agrotourism attractiveness of the districts of the Samarkand region. If we examine the level of influence of private agrotourism factors (arable land, orchards, vineyards, and forests) within this general integrated index, the agrotourism attractiveness of the district is directly influenced by the factor index of vineyards (0.058) to a high degree (Figure 3).

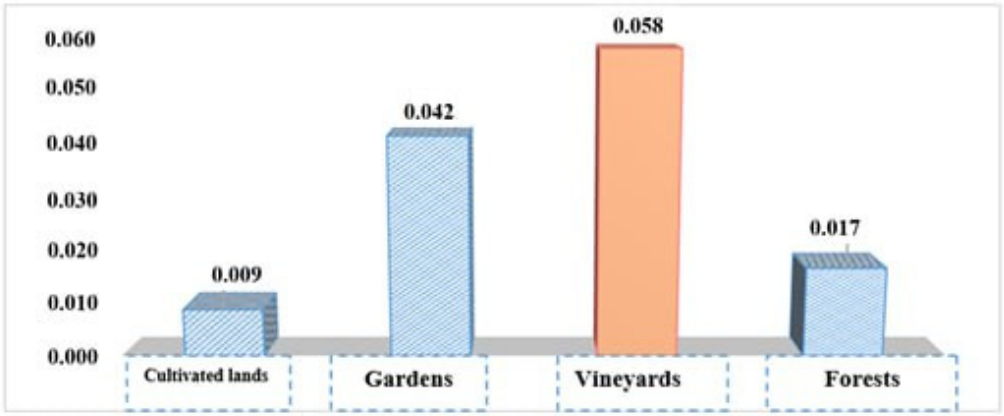

Figure 3. Attractiveness indices of private agrotourism factors in Samarkand district, as of 2023. Source: created by the authors.

Based on the grouping, it can be noted that most of the districts of the Samarkand region have agrotourism potential, the use of which will not only attract tourists but also create new agrotourism routes in these regions in the future. In the development of tourist route technology, the main focus is on facilitating and improving the tourism process. To create a useful route, this process should be simple and easy, with minimal cost and time. As a rule, computer programs that facilitate the work of specialists are used to organize the route. With the help of programs, you can create and edit maps and study the space of the future tourist route.

The development of tourist routes is carried out according to pre-selected routes, which have not only a specific period but also a specific purpose. The tourist route will be connected to certain areas, taking into account the facilities located in the area, and the possible directions of travel. A route has start and end points and is served by start and endpoints. According to the rule, the tourist route should be agreed upon in the contract with the tourist.

The technology of forming tour offerings is one of the technologies of providing tourist services, which consists of the development of a specific tourist product intended for the use of tourists. Agrotourist routes can be described as follows, based on the definitions of tourist routes provided by our local scientists in the literature sources: agrotourist path—"pre-defined objects to get acquainted with the interesting travel processes of the cultivation, processing, and sale of agricultural products of a certain place is the way of movement of a tourist or a group of tourists" (Yakubjonova 2019).

Agrotourism routes can be developed using the same fundamental ideas (guidelines) that underpin the construction of tourist routes. Differentiating between the agrotourism route concepts of alternative, complex, and informational travel, as well as attractiveness and uniqueness, opportunities, and meaningful travel are acceptable.

Development of agrotourist routes: carrying out reconnaissance (from Latin recognize-to watch); developing a project of agrotourist routes and putting it on a plan or map;

drafting a "note"; booklet and advertisements for receivers, guides, and tourists on each agrotourist route creation; and examination, including steps such as improving based on amendments and supplements and publishing them.

Considering the rational use of tourist opportunities in agrotourist regions of the Samarkand region, 4 routes were determined. Routes were divided into types according to the characteristics of tourist objects on them and represented on a map with a scale of 1:400,000 (Figure 4). From this point of view, the advantages of organizing a new agrotourist route with the possibility of receiving up to 100 agrotourists at the same time during the season in the modern intensive garden in the area of Kungirot village of the Jambay district in the direction of horticulture of agrotourism are given.

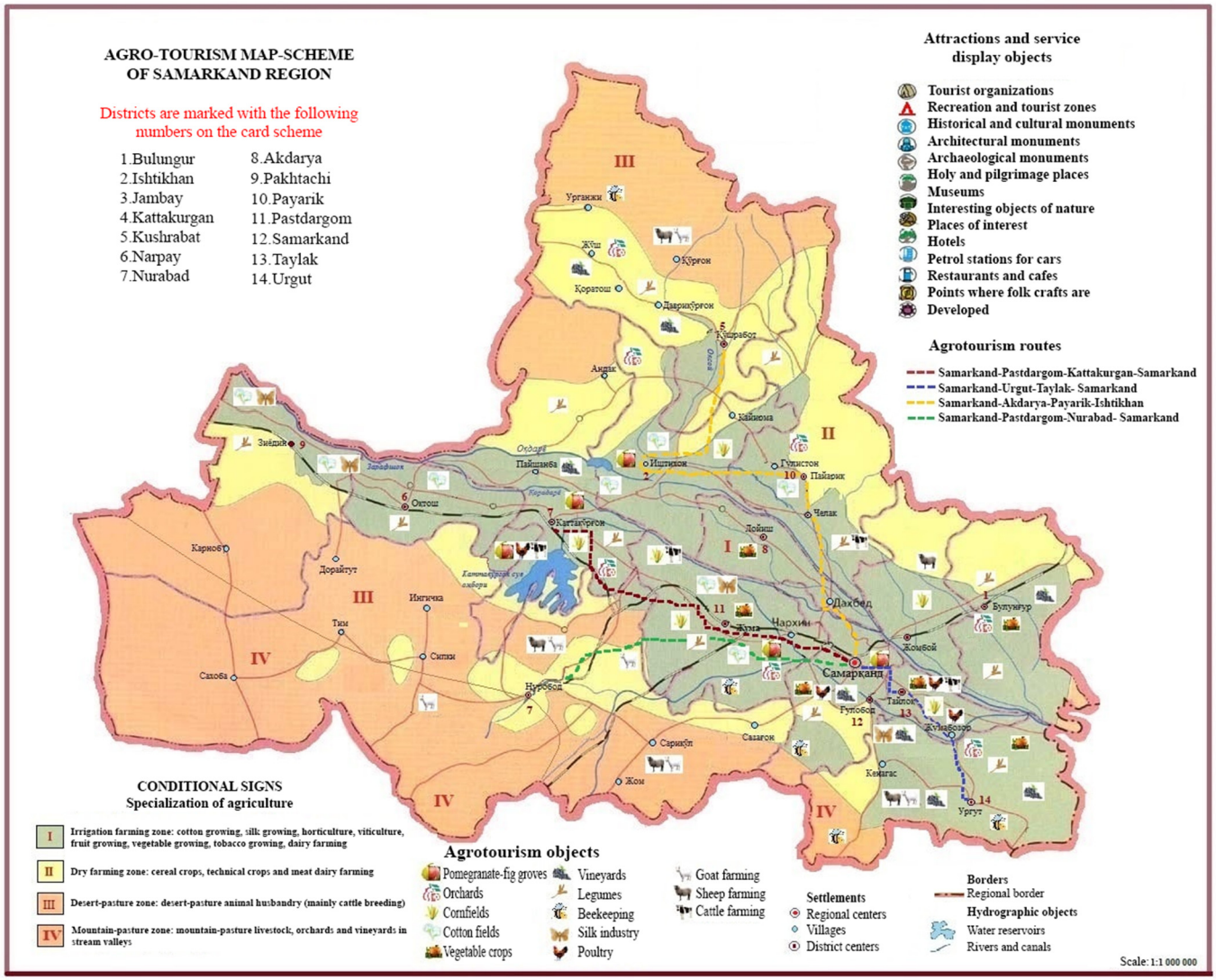

Figure 4. Scheme of agrotourism map of Samarkand region. Source: created by the authors.

Currently, efforts are being made to guarantee steady economic growth in the nation by developing social and economic infrastructure, increasing production intensity, and making structural adjustments. Macroeconomic stability in Uzbekistan is contingent upon and results from the country's stable socioeconomic development, which calls for the harmonious growth of the social and industrial spheres, raising the average citizenry's standard of living and enhancing the environment.

The goal of developing a theoretical and practical development strategy for each individual region is to guarantee the national economy's stability and security. Specifically, the sustainable development of rural areas is given special emphasis in decree No. PF-5853

issued by the President of the Republic of Uzbekistan on 23 October 2019, "On approval of the strategy of the development of agriculture of the Republic of Uzbekistan for 2020–2030". Consistent development of rural areas is intimately linked to improving the population's well-being and finding effective solutions to issues pertaining to the nation's sustainable economic growth.

One of the biggest issues facing rural communities nowadays is realizing the potential of national culture and traditional hospitality through the growth of agrotourism. Currently, as a distinct sector of the tourism industry that makes money from the extra non-agricultural activities that the rural population engages in, agrotourism is regulated by a well-designed normative legal framework; however, there are no regulations in place.

Apart from the absence of a legal framework, other factors contributing to the challenges in arranging agrotourism are:

- Inadequate or nonexistent infrastructure development in numerous rural regions;
- Insufficient knowledge about agrotourism and its benefits among rural inhabitants;
- The rural population shift from rural to urban areas, and an insufficiently skilled workforce for agrotourism growth;
- The absence of official and commercial agrotourism advertising;
- The absence of a cohesive national program and funding for the growth of agrotourism;
- The absence of a well-organized system and mechanism of cooperation between organizations that offer recreational opportunities for tourists in rural areas.

Other factors indirectly affect the development of tourism, such as climate change, stagnant market demand, and cultural conflicts. Currently, climate change, economic needs, and the rapid growth of tourism are causing social and cultural problems in many areas. As these processes reinforce each other, local cultures and traditions may collide with global demands. As climate change reduces water, soil, and other natural resources, the way local people live will change. This leads to the loss of ancient practices, farming, and other traditional activities. Climatic crises often cause people to move to other areas. This creates cultural conflicts in new areas. For example, indigenous people displaced by drought may come into conflict with traditional landowners over resources.

Global markets require domestic manufacturers to adapt to international requirements and standards. This increases the risk of losing local style and cultural identity. Market demand leads to the intermingling of cultural elements. This causes the popularization of culture on the one hand and the loss of its identity on the other. Increasing tourism leads to the commercialization of cultural elements. It can change the essence of traditions and customs. Tourists usually bring their own culture, which makes it difficult for local people to live according to their traditions. A large influx of tourists can quickly render local cultural sites obsolete and exacerbate these conflicts. For example, the adaptation of religious or historical sites in an area for the needs of tourists may cause resentment in the local community.

We present the following suggestions to mitigate and eliminate the effects of the above-mentioned symbiotic factors:

- It is important to involve the local population in the process of using cultural resources.
- Tourist activities should be managed based on local culture and ecological protection rules.
- It is necessary to develop information campaigns and educational programs for tourists and locals to understand each other's culture.
- Creating platforms for residents to properly introduce their culture to tourists (local art festivals, craft exhibitions, etc.).
- Engaging tourists to have a positive impact on local community life, for example through environmental projects or social initiatives.

Tourism development in Uzbekistan is backed by various economic policies and government strategies aimed at boosting the sector's contribution to the national economy. For instance, the Development Strategy of Uzbekistan for 2022–2026 prioritizes tourism

as a key sector, with policies aimed at improving infrastructure, increasing service quality, and promoting the country internationally (Presidential Decree No. PF-60 2022).

Uzbekistan's My.gov.uz portal offers essential digital services for foreign tourists, including e-visa applications, temporary residence registration, and business services. The portal also provides comprehensive travel information, such as details on tourist attractions, local cuisine, and safety measures, helping visitors plan their trips with ease. This platform supports Uzbekistan's tourism policy by attracting more international tourists, boosting local economies, and improving government service transparency. By integrating digital solutions, My.gov.uz strengthens the country's position as a culturally rich and visitor-friendly destination (My.Gov.Uz Public Services for Foreign Citizens 2024).

Uzbekistan has several official and specialized websites that promote its tourism potential and attract both domestic and international visitors. Uzbekistan.travel provides comprehensive information about the country's historical cities like Samarkand, Bukhara, and Khiva, alongside options for ecological and active tourism (Uzbekistan.Travel 2024). The State Committee for Tourism Development's website highlights government initiatives to expand tourism infrastructure (Tourism Committee 2024).

Local tourism agencies play a pivotal role in developing and promoting tourism in the Samarkand region. These agencies organize tours, promote new tourist routes, and collaborate with local governments to improve service delivery. They also contribute to the development of specialized tourism zones and clusters, which further enhance the attractiveness of the region (Safarov and Janzakov 2021).

Medical services and safety are important factors in tourism, and they significantly influence the choice of destination and the overall experience of tourists. The availability of medical services, especially the quality of healthcare infrastructure, is one of the important factors in attracting tourists. For example, India is gaining international attention in medical tourism with affordable prices and quality services. This trend is increasing the synergy between health and tourism, contributing to local economic development (Mehta and Ray 2023).

In terms of security, the tourism police play a crucial role in protecting tourists and building their confidence. In particular, police services help create a positive image of tourist destinations by maintaining order and preventing problems in tourist areas (Ganesan and Athimuthu 2021). Police presence is especially important to families and first-time visitors, who prefer places with a high level of security. In addition, the integration of community services, including medical and security services, increases the overall attractiveness of a place and encourages the return of tourists (Liu 2023).

Providing medical services and security necessary for tourism in the Samarkand region will greatly contribute to increasing the attractiveness of tourism. These factors provide tourists with a peaceful and safe travel experience in the area, increasing their confidence in the area.

The presence of modern medical services in the Samarkand region is important for recognition as a tourist destination that meets world standards. A modern and fast medical service system, especially tourist emergency centers, hospital intensive care units, and post-pandemic medical control services instill confidence among tourists. The location of the hospital and emergency services close to tourists, and medical security measures will help them spend their time in Samarkand to their heart's content (Jumanazarov et al. 2020).

Security services also play an important role in tourism. In the Samarkand region, police and security services provide additional control around tourist sites. This not only protects against minor offenses but also strengthens the sense of security among tourists. The presence of tourist security centers and constant police surveillance creates a safe environment for tourists, which in turn attracts more tourists to the area.

In conclusion, the achievements in the fields of medical services and security in Samarkand are important in increasing the tourism attractiveness of the region. They ensure that tourists travel happily and build trust in the area.

To further investigate the potential influence of governance indicators on inbound tourism, we analyzed the correlation between key governance variables and the number of incoming tourists in the Samarkand region. Specifically, we examined the relationships between the number of inbound tourists and the following World Bank governance indicators: Political Stability and Absence of Violence/Terrorism, Rule of Law, Control of Corruption, and Voice and Accountability (Figure 5).

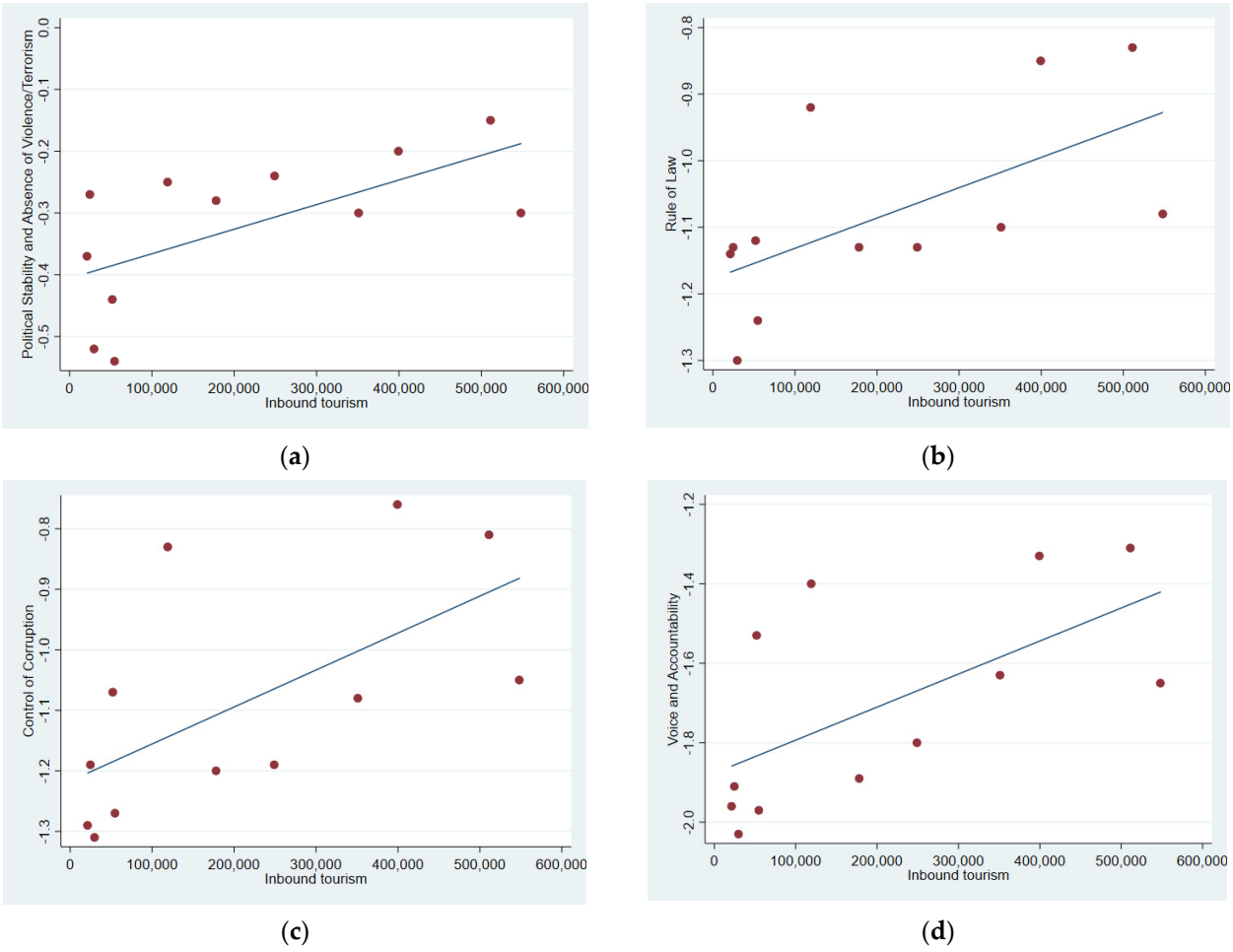

Figure 5. Correlation between governance indicators and inbound tourism in Samarkand region (2012–2023): (**a**) Political Stability and Absence of Violence/Terrorism vs. Inbound Tourism; (**b**) Rule of Law vs. Inbound Tourism; (**c**) Control of Corruption vs. Inbound Tourism; (**d**) Voice and Accountability vs. Inbound Tourism. Source: developed by the authors using STATA 15 software and data from the World Bank and the Tourism Department of the Samarkand region (2012–2023).

Figure 5 presents the scatter plots for these relationships: (a) Political Stability and Absence of Violence/Terrorism vs. Inbound Tourism, correlation coefficient 0.6376; (b) Rule of Law vs. Inbound Tourism, correlation coefficient 0.6198; (c) Control of Corruption vs. Inbound Tourism, correlation coefficient 0.6206; and (d) Voice and Accountability vs. Inbound Tourism, correlation coefficient 0.6224.

The analysis covers data for the period from 2012 to 2023, using governance indicators provided by the World Bank and inbound tourism statistics sourced from the Tourism Department of the Samarkand Region. These results reveal moderate to strong positive correlations between governance indicators and inbound tourism.

Improved governance fosters a safer and more attractive environment for foreign tourists. For instance, higher political stability and adherence to the rule of law ensure safety and enhance the overall travel experience. Similarly, effective corruption control and

strong democratic practices, as measured by Voice and Accountability, promote fairness and inclusivity, increasing tourists' confidence and willingness to visit.

Enhancing governance dimensions is essential for boosting international tourism in the Samarkand region. These findings provide valuable insights for policymakers to focus on governance improvements as a means to attract more tourists, thereby contributing to the region's socio-economic growth.

During the research, we identified the following factors affecting the volume of services to tourists in the Samarkand region:

X_1—number of domestic tourists, person; X_2—number of incoming tourists, person; X_3—number of tourist organizations, unit; X_4—number of farms, unit; X_5—an area of cultivated land, hectare; X_6—garden area, hectare; X_7—vineyard area, hectare; and Y—the volume of services provided to tourists, billion Uzbekistani sum (UZS).

In this study, we tried to test the following hypothesis:

$H_0 - X_1$, X_2, X_3, X_4, X_5, X_6, and X_7 influence of at least one factor on Y is statistically significant. $H_1 - X_1$, X_2, X_3, X_4, X_5, X_6, X_7 none of the factors' influence on Y is statistically significant. The dynamics of change of these factors and voluntary variables from 2012 to 2023 are presented in Table 7 below.

Table 7. Dynamics of factors affecting the change in the volume of tourist services in Samarkand region.

Years	Domestic Tourism, Person	Inbound Tourism, Person	Number of Tourist Organizations, Unit	Number of Farms, Unit	Arable Land Area, Hectare	Garden Area, Hectare	Vineyard Area, Hectare	Volume of Services Provided to Tourists, Billion UZS
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	Y
2012	13,785	29,678	46	27,528	267,655	27,581	26,511	15.2
2013	38,237	54,655	48	10,106	262,345	27,615	26,545	14.7
2014	7051	24,606	46	11,993	268,778	27,680	26,658	8.0
2015	10,144	21,194	52	18,778	260,227	28,431	27,336	7.9
2016	980,000	178,000	56	19,947	258,967	28,645	27,567	281.9
2017	1,140,000	249,000	57	21,844	250,268	29,115	28,385	338.1
2018	2,000,086	351,000	50	16,789	246,439	30,581	30,511	503.0
2019	2,408,012	548,102	56	12,398	246,983	30,022	29,656	688.0
2020	581,224	51,970	45	12,123	246,942	30,020	29,656	112.0
2021	1,943,382	119,012	52	11,845	245,555	30,417	23,853	230.0
2022	4,247,000	399,316	57	11,740	244,350	30,428	23,757	468.5
2023	4,500,000	511,153	136	11,548	244,155	30,457	23,690	488.7

Source: created by authors based on government reports.

First of all, we made a correlation matrix and found it appropriate to evaluate the degree of correlation between the factors (Table 8).

Table 8. Correlation matrix of factors affecting the change in the volume of tourist services in Samarkand region.

	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y	1.0000							
X_1	0.8042	1.0000						
X_2	0.9654	0.8627	1.0000					
X_3	0.4139	0.6797	0.5821	1.0000				
X_4	−0.2178	−0.3914	−0.2652	−0.2205	1.0000			
X_5	−0.7654	−0.7835	−0.7077	−0.3932	0.4090	1.0000		
X_6	0.7666	0.7937	0.6971	0.3784	−0.3980	−0.9704	1.0000	
X_7	0.1000	−0.4352	−0.0309	−0.4581	0.2448	0.0445	−0.0456	1.0000

Note: using the observations 2012–2023, 5% critical value (two-tailed) = 0.5760 for n = 12.

There is a strong correlation (greater than 0.7) between factor X_1 with factors X_2, X_5, and X_6, and between factors X_2 and X_5. It can also be seen that the correlation coefficient between the X_5 and X_6 factors is greater than 0.9. To eliminate the problem of multicollinearity, exclude the factors X_1 and X_5 from the analysis. In addition, since the influence of the X_7 factor on the final Y is very small (0.1), we believe that this factor can be excluded from the model. Thus, we leave only X_2, X_3, X_4, and X_6 factors in the analysis and propose the following theoretical model to achieve the research objective (7):

$$Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_6 X_6 + \epsilon, \quad (7)$$

where β_0, β_2, β_3, β_4, β_6—coefficients representing parameters of the model; ϵ—error.

Based on the above, we obtained the following results using the Gretl program based on the Ordinary Least Squares (OLS) method (Table 9).

Table 9. The results of the econometric analysis of the factors affecting the change in the volume of tourist services in Samarkand region.

	Coefficient	**Std. Error**	**t-Ratio**	***p*-Value**	
const	−1063.32	399.076	−2.664	0.0323	**
X_2	0.00116381	9.03×10^{-5}	12.89	<0.0001	***
X_3	−1.98291	0.553956	−3.580	0.0090	***
X_4	0.00316027	0.00224970	1.405	0.2029	
X_6	0.0392108	0.0134900	2.907	0.0228	**
Mean dependent var		263.0000	S.D. dependent var	236.3437	
Sum squared resid		9511.242	S.E. of regression	36.86121	
R-squared		0.984521	Adjusted R-squared	0.975675	
F(4, 7)		111.3028	*p*-value (F)	2.05×10^{-6}	
Log-likelihood		−57.07920	Akaike criterion	124.1584	
Schwarz criterion		126.5829	Hannan–Quinn	123.2608	
rho		−0.242288	Durbin–Watson	2.365781	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Here, it can be seen that the p-value for factors X_2, X_3, and X_6 is less than 0.05. That is, at the 95% confidence level, the influence of factors X_2, X_3, and X_6 on Y is statistically significant. The influence of the X_4 factor is not statistically significant. Based on this, the following regression equation can be constructed (8):

$$Y = 0.00116381X_2 - 1.98291X_3 + 0.0392108X_6 - 1063.32 \quad (8)$$

That is, an increase in the number of incoming tourists by 1000 people will increase the volume of services provided to tourists by UZS 1.16 billion, and an increase in the area of parks by 1000 hectares will increase the volume of tourist services by UZS 39.21 billion. In other words, the greater allocation of economic resources to the expansion of parks has a positive effect on the increase in the volume of tourism services. At the same time, it can be seen that the R-squared value of this model is 98.4%, which means that the independent variables included in the model explain 98.4% of the increase or decrease in the dependent variable.

Using Equation (8), it becomes possible to forecast the volume of paid tourist services. In this case, we assumed that the variables X_2, X_3, and X_6 change along a linear trend, and with the help of the Gretl program, we got the following (9)–(11):

$$X_{2t} = 36,451.8t - 7.33299 \times 10^{-7} \quad (9)$$

$$X_{3t} = 3.74476t - 7496.63 \quad (10)$$

$$X_{6t} = 313.476t - 603,188 \quad (11)$$

Here, t—years. Through Equations (8)–(11), we get the forecast values in Table 10.

Table 10. Forecast of tourist service volumes and factors influencing them in Samarkand region (2024–2027).

Years	Inbound Tourism, Person	Number of Tourist Organizations, Unit	Garden Area, Hectare	Volume of Services Provided to Tourists, Billion UZS
	X_2	X_3	X_6	Y
2024	448,543	83	31,287	521.4
2025	484,995	87	31,601	568.7
2026	521,447	90	31,914	616.0
2027	557,899	94	32,228	663.3

Source: created by authors.

That is, according to our forecast, by 2027, the number of incoming tourists will increase by 109.1% compared to 2023, and the volume of paid tourist services will be 146.8% compared to 2021, respectively. During this period, the trend of increasing the area of parks will continue. Also, the value of tourist services demonstrates a steady growth trend (Figure 6).

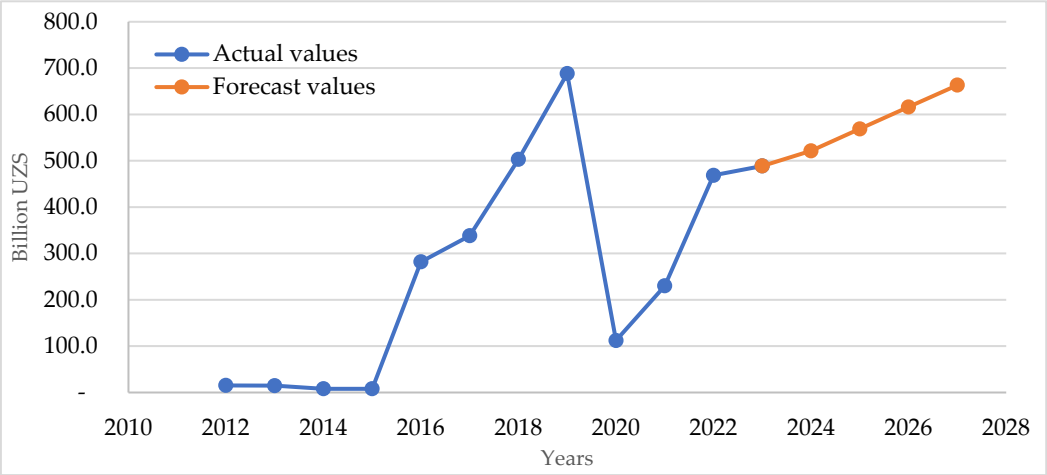

Figure 6. Actual (2012–2023) and forecast (2024–2027) values of tourist services in the Samarkand region. Source: created by the authors.

The forecast is also within the 95% confidence interval as shown in Figure 7, which means that the forecast results can be considered reliable.

Forecasts show that tourism is expected to grow in the future. The decline after the peak in 2019 is due to COVID-19, while the growth in 2021–2023 indicates a positive impact on the sector. Forecasts and confidence intervals provide reliable estimates of the future state of the tourism sphere.

To further enhance the predictive power and validate the robustness of this study, a Random Forest model was applied to analyze the factors influencing the volume of services provided to tourists in the Samarkand region. This machine learning approach was chosen for its ability to handle complex, nonlinear relationships and interactions between variables without requiring stringent assumptions about the data.

The analysis was conducted in RStudio using data presented in Table 7, which span the years 2012 to 2023. The Random Forest model, configured with 500 decision trees, demonstrated a high level of accuracy, with an R^2 of 0.93 and an explained variance of 67.43%. These metrics indicate that the independent variables accounted for a significant portion of the variation in the dependent variable. The Mean Squared Error (MSE) of 16,678.35 further supports the model's reliability (Table 11).

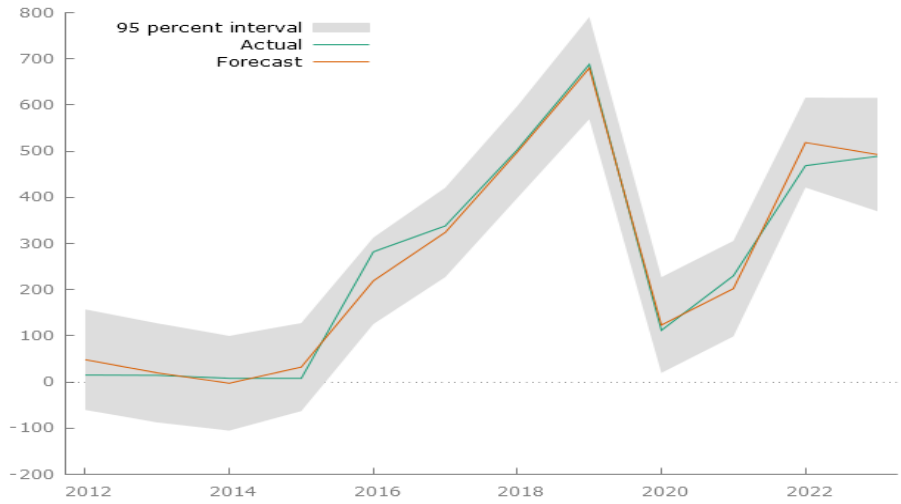

Figure 7. Actual and forecast values of tourism services in the Samarkand region with 95% confidence intervals (2012–2023). Note: Mean Error: 5.8324×10^{-14}; Root Mean Squared Error: 28.153; Mean Absolute Error: 21.377; Theil's U: 0.24675. Source: created by the authors.

Table 11. Key metrics of the Random Forest Regression model.

Metric	Value
Number of trees (ntree)	500
Number of variables tried at each split (mtry)	2
Explained Variance (% Var Explained)	67.43
R^2	0.9258216
MSE (Mean Squared Error)	16,678.35

Source: generated by the authors using Random Forest analysis in RStudio.

The Random Forest model applied in this study not only provided strong predictive performance but also leveraged the Out-of-Bag (OOB) error method for internal validation. The OOB error is an intrinsic feature of Random Forest models, enabling an unbiased evaluation of prediction accuracy without the need for separate test data. This approach is particularly advantageous when data are limited, as it maximizes the use of available information for both training and validation (Schonlau 2023; Marques F. 2022).

As shown in Figure 8, the OOB error rate stabilizes after approximately 200 trees, affirming the robustness of the model configuration. The inclusion of 500 trees ensures the model captures the underlying patterns in the data effectively while avoiding overfitting.

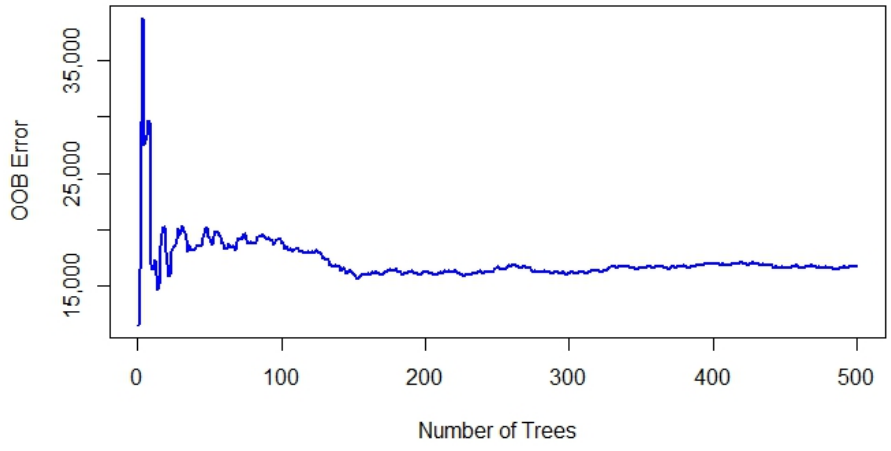

Figure 8. OOB Error and number of Trees in Random Forest model. Source: generated by the authors using Random Forest analysis in RStudio.

The importance of each variable in predicting the target outcome was assessed using two metrics: X.IncMSE and IncNodePurity (Table 12). The results revealed that inbound tourism, domestic tourism, and garden areas are the most influential factors. Inbound tourism showed the highest importance (X.IncMSE = 11.13), followed by domestic tourism (X.IncMSE = 8.73) and garden areas (X.IncMSE = 5.81). These findings underscore the critical role of both tourist inflows and the availability of garden areas in driving the volume of services provided to tourists.

Table 12. Importance of variables in predicting the volume of services provided to tourists.

Variable	X.IncMSE	IncNodePurity
Domestic tourism (X1)	8.727694543	128,622.08
Inbound tourism (X2)	11.131096766	148,338.09
Number of tourist organizations (X3)	4.819260050	66,046.81
Number of farms (X4)	−1.939134668	12,712.84
Arable land area (X5)	4.935782786	60,744.46
Garden area (X6)	5.813373292	83,824.49
Vineyard area (X7)	0.008216879	26,035.89

Source: generated by the authors using Random Forest analysis in RStudio.

The model's predictive performance was evaluated by comparing actual and predicted values. Figure 9 illustrates a strong alignment between the two, emphasizing the model's accuracy in predicting the volume of tourist services.

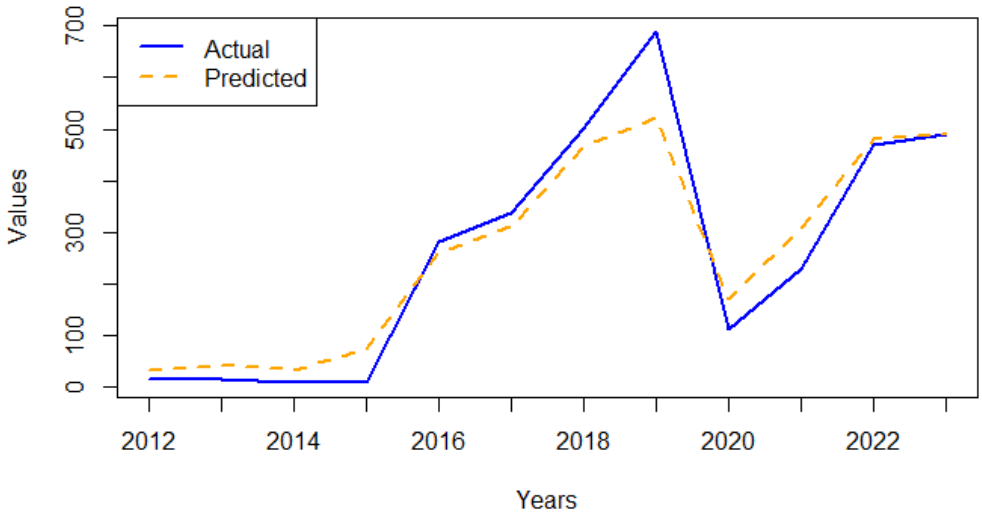

Figure 9. Actual and predicted values of volume of services provided to tourists in the Samarkand region (2012–2023). Source: generated by the authors using Random Forest analysis in RStudio.

The findings suggest that policies aimed at increasing inbound tourism and domestic tourism, alongside better utilization of garden areas for tourism activities, could significantly enhance the volume of services provided in the region. Incorporating machine learning techniques like Random Forest allows for a more nuanced understanding of the factors influencing sector growth, providing actionable insights for regional policymakers and stakeholders. We believe that putting the following policies into place will help agrotourism grow across the nation:

1. Establishing regional networks of agrotourism businesses based on public–private partnerships, which entails both state support for such entrepreneurship at the regional level and encouraging the growth of family businesses, small businesses, and individual entrepreneurship based on the existing rural area tourist resources.

2. The creation or reconstruction, based on the tourist resources of rural areas, of the socio-cultural environment of historical settlements, such as national villages, tourism villages, farms, etc.

3. The establishment of cultural–historical complexes and other sizable and medium-sized specialized agrotourism establishments with the goal of planning comprehensive leisure initiatives in rural regions.

4. A multipurpose "village" comprising production, tourist, cultural and promotional, exhibition, advertising, and exposition purposes, with the required infrastructure and housing amenities, and based on state, private, and mixed ownership. The development of "Agriculture parks". Large private investors may find these agrotourism strategies to be a viable alternative to the tourism sector.

Furthermore, the development of agritourism presents distinctive challenges and opportunities in the domain of environmental sustainability. As the number of tourists increases, it becomes essential to implement effective waste management systems, optimize water use, and implement conservation practices in order to ensure the long-term viability of agrotourism initiatives. In the case of Samarkand, for example, the growth in inbound tourism and the concomitant increase in pollutant emissions have given rise to the need for a targeted approach to the mitigation of environmental impacts (Figure 10).

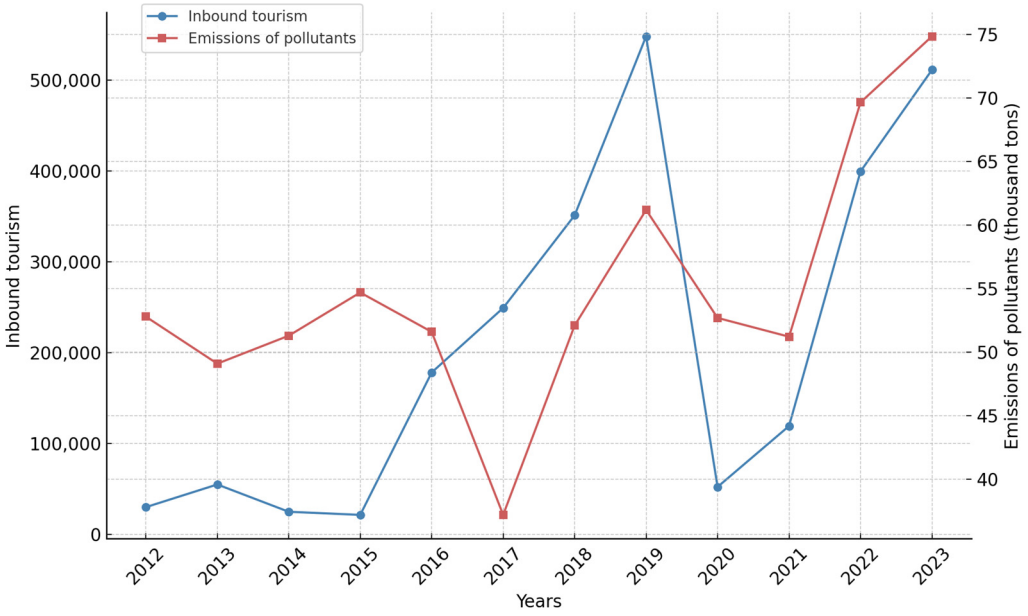

Figure 10. Trends in inbound tourism and atmospheric pollutant emissions in Samarkand region (2012–2023). Source: created by the author based on data from the Statistics Agency.

In order to enhance sustainability, efforts must be directed towards the reduction of waste generated from agrotourism sites through the implementation of recycling and composting initiatives. Furthermore, the implementation of water-efficient technologies for irrigation and sanitary systems can assist in the conservation of critical water resources. The establishment of protected zones around agrotourism clusters will additionally contribute to the conservation of biodiversity and the maintenance of ecological balance.

These measures not only reinforce the environmental sustainability of agrotourism but also align with global sustainable tourism practices. The incorporation of these strategies will enable regions like Samarkand to more effectively integrate environmental concerns into their agrotourism models, thus promoting a holistic approach to sustainable development.

For future development and to make this article more practical, I propose a pilot project for the village of "Kumushkent", Akdarya district, Samarkand region. The local government fully supports this project. The regional and district department of tourism development will promote agrotourism services in the tourism market. Along with this,

the volume of food resources will be increased, additional jobs will be created, and the social and living conditions of the settlement "Kumushkent" will be improved.

5. Conclusions

We feel that the idea of agrotourism growth should be pushed in multiple directions rather than just one, taking into consideration the distinctive qualities of the area, most notably the diversity of local factors. Depending on the territorial peculiarities of each district, multiple models can be utilized for the concept's development. It may contain a number of models that show promise given the requirements of the Samarkand region. Agrotourism, ecotourism, and ethnotourism are the three categories into which tourism can be subdivided. In order to bring these diverse agrotourism directions together harmoniously, we advise developing the following agrotourism directions in accordance with the circumstances in rural areas:

- Agrotourism (agrotourism complexes around sanatorium-resort zones and places of mass tourist visits);
- Agro-ecotourism;
- Agro-ethnotourism;
- Agro-eco-ethnotourism.

We shall take a closer look at these approaches. The development of agrotourism close to the Samarkand region's center is ideal. The following elements make up the agrotourism attractiveness in these regions' rural settlements:

- The potential customer should be informed about the state of the agrotourist facility in this village;
- A variety of natural landscapes (from the perspective of city dwellers, there should be pleasant landscapes near the rural settlement);
- Proximity to the industrial center (the trip time to the address should not exceed an hour);
- The accessibility of infrastructural components, such as parking lots, highways, and communication systems;
- A sufficient material and technological foundation, such as the availability of hygienic and comfortable residential structures with designated guest rooms.

The provision of cultural resources related to hospitality (certain aspects of rural life, such as fishing, horseback riding, caring for domestic animals, etc.), might meet visitors' needs during a brief visit.

Drawing on the carried-out investigation, we propose optimistic avenues for the advancement of agrotourism in Uzbekistan:

- Establishment of a "small family business" focused on agrotourism within the respective regions. Establishment of "Village House", "Agro-Farmer's House", and "Village Hotel" in rural areas;
- The creation of an "agrotourism cluster" that will have the power to create marketing plans, brand identities, advertising campaigns, and other development-related matters in each region. Both public and private parks are being created. This model's primary characteristics are the support of agriculture and the resuscitation of customs and crafts, in addition to the growth of tourism;
- Multifunctional "agriculture" with a state, private, or mixed ownership structure that combines the production, tourism, cultural, and promotional aspects, as well as advertising, exposition, and exhibition roles; it also has the required residential amenities and infrastructure to be developed into "parks";
- Revitalization of tour operators in rural areas. At the same time, organizing the activities of the farmer-operator specialty in the field of agritourism;
- Formation of a system of training, retraining, and professional development of specialists in the areas of agrotourism, agro-ecotourism, agro-ethnotourism;

- Establishment of an "Agrotourism Association" coordinating the organizational–economic and monitoring functions of agriculture and tourism.

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