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Geoinformation Internet Platform for Interactive Charity Tourism in the Current Realities of Ukraine

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Abstract: In the context of armed conflicts, regions often face infrastructure destruction and economic difficulties. The development of tourism can be a key factor in recovery and economic growth. Geospatial platforms for interactive charitable tourism offer a promising solution for attracting tourists and stimulating the development of affected regions. The aim of this study is to assess the effectiveness of geospatial platforms for interactive charitable tourism as a tool for attracting tourists and promoting the recovery and development of regions affected by armed conflicts. This study employed regression and correlation analysis methods. The analysis revealed significant positive correlations for all variables. The correlation coefficient for audience reach was 0.75, for the effectiveness of attracting donations—0.8, for the economic impact on the region—0.9, for user interaction with the platform—0.85, for platform sustainability—0.78, and for social impact—0.92. The t-statistic values exceeded the critical thresholds, and the p-values were below 0.05, confirming the statistical significance of the results. The coefficient of determination was 0.91, indicating a high explanatory power of the model. For the four obtained clusters, approaches to the development and use of geospatial platforms were justified. For regions of Cluster 1 with high audience reach (0.75) and moderate effectiveness of attracting donations (0.8), it is recommended to use technologies to improve connectivity and effectively promote their strengths. For regions of Cluster 2 with high sustainability and high tourism potential (high social impact = 0.92), it is necessary to include advanced geospatial solutions to increase visitor engagement and optimize recovery strategies, building on existing strengths to attract more tourists and stimulate sustainable development. For regions of Cluster 3, significant investments are required both in geospatial platforms and in tourism infrastructure to benefit from high tourism potential (economic impact on the region = 0.9). Strategic development and targeted marketing should be a priority to attract tourists and stimulate economic growth. Regions of Cluster 4 with low sustainability and tourism potential (low user interaction with the platform = 0.85 and platform sustainability = 0.78) require comprehensive support, as they are in a crisis situation.

Keywords: geographic information systems; platform; digitalization; interactive charity tourism; military conflict; restoration



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1. Introduction

In the current digital era, internet technologies have transformed various sectors, including tourism and philanthropy. The global rise of digital platforms offers new opportunities for interaction, coordination, and support across different communities facing

crises. One notable innovation is the integration of geospatial technologies into charitable tourism, which provides a strategic framework for addressing humanitarian needs. While this article focuses on Ukraine, a country severely impacted by an ongoing military conflict, the concept of interactive charitable tourism is relevant to regions worldwide dealing with crises such as natural disasters, economic downturns, or political unrest.

Ukraine is facing immense humanitarian challenges, including the destruction of infrastructure, large-scale population displacement, and limited resources for recovery. These crises have led to the exploration of new tools that can enhance resilience and streamline support efforts. Geospatial platforms are emerging as an innovative solution by creating interactive maps of urgent needs and coordinating the distribution of resources. These platforms enable real-time monitoring, facilitate volunteer missions, and ensure transparency in the allocation of aid.

The purpose of this paper is to examine how geospatial platforms for interactive charitable tourism can not only support war-affected regions in Ukraine but also offer broader insights into how such technologies might be applied globally in other contexts of crisis. This study aims to assess the role of the developing internet ecosystem in fostering effective collaboration between donors, volunteers, and local communities, making the research applicable to diverse global settings.

The key research question this article addresses is as follows: How can a geospatial platform enhance the effectiveness of charitable tourism and contribute to sustainable recovery efforts in regions affected by crises? This question will guide the analysis, ensuring a focused examination of the topic. Furthermore, the literature review will be organized to highlight global examples of how geospatial technologies and digital ecosystems have been utilized in crisis management and recovery efforts, providing a comparative perspective to strengthen the research's broader relevance.

1.1. Geoinformation Technologies and Platforms

A review of the scientific literature on geospatial technologies and platforms reveals their vital role in managing and supporting processes across various sectors. However, for the purposes of this study, the focus is specifically on how these technologies can enhance charitable tourism efforts during crises, such as the war in Ukraine. Charitable tourism, driven by geospatial platforms, enables precise identification of affected areas and optimizes resource allocation by leveraging spatial data. Burak K. and Dorosh L. emphasize the potential of using accessible data, such as that from Google Earth, to develop cost-effective geospatial platforms [1]. These platforms are especially beneficial in resource-constrained environments like war-affected regions in Ukraine, where affordability and flexibility are critical for supporting charitable efforts. It has been highlighted that geospatial technologies are effective in improving coordination and communication during emergencies [2]. In the context of charitable tourism, such technologies enhance collaboration between donors, volunteers, and local communities, ensuring that aid reaches those in need more efficiently. The computational infrastructure required for processing large volumes of spatial data, including the integration of cloud technologies and high-performance computing, is discussed in recent research [3]. This is particularly relevant for managing the growing data associated with charitable tourism, which requires real-time tracking of needs and resources across multiple regions. Shaparev N. and Yakubailik O. examine web-based mapping systems, which are essential for transparency and accountability in managing charitable donations and support missions [4]. These systems can provide real-time updates on the status of aid distribution, offering a clear view to stakeholders and ensuring trust in the process. The importance of using geospatial platforms for monitoring the socio-economic development of territories, particularly in post-conflict regions like Ukraine, is emphasized in recent research [5]. By analyzing spatial data, these platforms can help track the long-term impacts of charitable tourism on regional recovery and sustainability. In summary, geospatial technologies not only support emergency management but also play a pivotal role in charitable tourism by enhancing resource allocation, transparency, and

long-term monitoring. In the current realities of Ukraine, these platforms are essential for coordinating aid efforts and supporting sustainable recovery.

1.2. Internet Ecosystem and Digitalization

The analysis of the internet ecosystem and digitalization highlights key technological developments that are particularly relevant for supporting geospatial platforms in charitable tourism, especially during crisis situations like the war in Ukraine. While various studies explore the broader context of digitalization, the focus here is on their specific application in facilitating interactive charitable tourism. Dhamdhare A. and Dovrolis C. examine the evolution of the internet ecosystem, underscoring the need for scalable and sustainable solutions for managing internet traffic and network resources [6]. This is crucial for ensuring the stable operation of geospatial platforms that support tourism and humanitarian efforts in crisis zones, where consistent access to digital services is vital for coordination and aid delivery. The challenges of integrating the “Internet of Things” (IoT) in fragmented ecosystems, especially in remote or crisis-affected areas, are addressed in recent research [7]. Their findings are directly applicable to charitable tourism, as IoT technologies can monitor resources on the ground, facilitate communication, and ensure real-time data transfer to track needs and volunteer activities in war-affected regions of Ukraine. The role of content delivery networks (CDNs) in managing internet ecosystems under high network load conditions is analyzed in recent research [8]. This has direct implications for the uninterrupted operation of a geospatial platform for charitable tourism, where a high-quality user experience and stable access are essential for coordinating aid and facilitating volunteer participation. Vermesan O. and Friess P. highlight the convergence of IoT within “smart” environments, which can dynamically adapt to crises [9]. This technology is especially relevant for geospatial platforms, enabling real-time data collection on tourist activities and ensuring safety in crisis situations like those in Ukraine. The integration of IoT into these platforms allows for more efficient management of tourist routes and the allocation of charitable resources. The optimization of distributed computing resources and real-time data analysis in mobile internet ecosystems is explored in recent research [10]. This technology can be applied to charitable tourism by supporting mobile applications that facilitate donor engagement, volunteer coordination, and data-driven decision-making for resource distribution in war-torn regions. In summary, the literature emphasizes the critical role of digitalization and the internet ecosystem in creating and sustaining geospatial platforms for charitable tourism. These technologies enable real-time monitoring, data integration, and efficient resource management, all of which are essential for addressing the unique challenges presented by the Ukrainian war crisis.

1.3. Charity and Volunteer Tourism and Its Impact on Local Communities

The review of sources on charity and volunteer tourism highlights crucial aspects of its impact on local communities, with a focus on the creation of geospatial platforms that can support charitable tourism in Ukraine during the ongoing military crisis. The potential negative effects of volunteer tourism, such as dependency on external aid, economic distortions, and superficial engagement with local issues, are highlighted in recent studies [11]. These risks are critical to consider when designing geospatial platforms to ensure that charitable tourism initiatives promote sustainable, long-term positive outcomes for Ukrainian communities. Effective governance is essential in voluntourism, and collaboration with local government and business is considered by McCabe S., Johnson S. and others to be a key factor in success [12,13]. This collaboration is vital in Ukraine, where charitable tourism projects should aim not only to provide immediate support but also to contribute to the socio-economic recovery of regions affected by war. The inclusion of local stakeholders ensures that the geospatial platform aligns with the real needs of the communities. Studies show that volunteers travel not only for altruistic reasons but also to broaden their horizons and gain a deeper understanding of other cultures [14,15]. This insight can be leveraged in the design of the geospatial platform by offering volunteers opportunities for

skill development and meaningful cultural exchange, thereby enhancing their engagement and long-term commitment. Simpson K. highlights the risks of short-term, superficial volunteer projects, which can undermine long-term development [16]. For Ukraine, it is essential that charitable tourism initiatives supported by the geospatial platform prioritize sustainable development goals, avoiding the pitfalls of temporary interventions. Buhalis D. similarly emphasizes the importance of long-term impact in tourism development [17]. Johansson F. discusses the misalignment between volunteer actions and local needs, pointing to the importance of thorough needs assessments [18]. This is particularly relevant for Ukraine, where charitable tourism projects must be designed in close consultation with local communities to ensure that they address both cultural and socio-economic challenges. Recent studies have highlighted the dual impact of volunteer tourism on local communities, emphasizing the importance of sustainable practices, community involvement, and addressing genuine needs for successful projects [19]. The proposed geospatial platform should therefore prioritize initiatives that involve local stakeholders and foster long-term positive changes, ensuring that the benefits of charitable tourism extend beyond immediate crisis response.

1.4. Sustainable Development and Digital Tourism

The analysis of sources on sustainable development and digital tourism reveals how digital technologies play a crucial role in advancing rural tourism, particularly in the context of crises and global changes. Alonso N., Vicent L. and Trillo D. emphasize that digitalization has significantly enhanced rural tourism by improving access to information, interaction with tourists, and creating new service forms [20]. This is particularly relevant for the development of geospatial platforms, which can facilitate the promotion of rural tourism and charitable activities in crisis-stricken regions like Ukraine. The advent of digital technologies has provided small and remote destinations with the means to improve their market visibility and foster long-term economic viability [21]. For Ukraine, where many rural areas face challenges due to the military crisis, geospatial platforms can support local communities by promoting sustainable tourism and recovery efforts. Bobek V., Gotal G. and Horvat T. specifically discuss the impact of the 2022 war in Ukraine on travel habits, which underlines the need for adaptive tourism solutions, including digital platforms, to address the changing demands and preferences of both tourists and locals [22]. Đorđević D., Šušić V. and Janjić I. argue that rural tourism must adopt a sustainable approach, integrating digital tools to preserve natural and cultural resources [23]. This aligns with the goals of developing a geospatial platform for charitable tourism, which should ensure the long-term sustainability and resilience of rural regions in Ukraine. The importance of adapting tourism to crises is further discussed by Goodwin H. and Francis J., who emphasize the need for local economies to pivot towards more sustainable practices during crises [24]. In Ukraine, this adaptation can be facilitated by digital platforms, enabling local businesses and communities to offer services that cater to both tourists and charitable efforts. Currie D., Skare M. and Loncar J. explored the broader effects of war on tourism, using Croatia as a case study, and concluded that rebuilding tourism requires an emphasis on local sustainability—an insight that can inform the development of similar strategies in Ukraine [25]. The application of digital technologies, according to some authors, has become a promising avenue for developing environmentally responsible tourism, especially in rural areas affected by conflict [26]. This is vital for Ukraine, where geospatial platforms can play a key role in attracting tourists and supporting the rural economy during the recovery period. Additionally, Kim M.J., Chung N. and Lee C.K. highlight the role of perceived trust in digital tourism services, which underscores the importance of building reliable and user-friendly platforms to encourage both domestic and international participation in charitable tourism efforts [27]. Recent research has demonstrated that resilience benchmarking can significantly enhance the survival and growth prospects of small businesses, including rural hotels, in the face of global challenges [28]. This finding is directly applicable to the geospatial platform's design, ensuring that it provides tools not

only for tourists and volunteers but also for local businesses to enhance their sustainability during and after the military crisis. Finally, a new study explores how combining circular economy concepts with inclusive approaches can help mitigate environmental threats in rural areas affected by conflict [29]. This research underlines the importance of integrating sustainable and digital solutions into the management of rural regions [30]. In the context of geospatial platforms, these solutions can support the preservation of ecosystems and promote the long-term recovery of local communities in Ukraine [31]. In conclusion, the role of digitalization in rural and charitable tourism is central to sustainable development, particularly during crises like the current military conflict in Ukraine. The development of geospatial platforms for charitable tourism can address these challenges by promoting long-term economic sustainability, supporting local communities, and fostering inclusive growth in affected regions.

1.5. Hypothesis and Objectives of the Study

Research Hypothesis: “A geospatial platform for interactive charitable tourism can become an effective tool for attracting tourists to regions affected by armed conflicts, contributing to their recovery and development.”

Research objectives:

- Develop a concept and prototype of the platform for testing and receiving feedback from potential users.
- Test the platform in selected regions to assess its effectiveness in attracting tourists, stimulating the local economy, and raising awareness of regional problems.
- Evaluate the platform’s impact on the socio-economic development of the region, including job creation, increased local incomes, and the development of small businesses.

Expected results:

- A functional platform allowing tourists to plan trips to affected regions, and obtain information about local attractions, recovery projects, and volunteer opportunities.
- Increased awareness of the problems faced by affected regions and attracting attention to the need for humanitarian aid.
- Attracting tourists to affected regions, contributing to the restoration of the local economy.
- Creating new jobs and stimulating the development of small tourism-related businesses.
- Creating conditions for deeper interaction between tourists and local residents, contributing to mutual understanding and cooperation.
- Developing recommendations for the development and implementation of similar platforms in other regions affected by armed conflicts.

The research was conducted in 2022–2023 based on a survey of tourism enterprises in various regions of Ukraine.

2. Materials and Methods

2.1. Methodology for Assessing the Impact of Digitalization and Donation Tourism on the Sustainability of Rural Areas in War Conditions

To select a geospatial platform that effectively supports interactive charitable tourism during a military crisis, several key performance indicators must be considered. These indicators can be expressed through calculation formulas that will help assess the platform’s effectiveness according to various criteria.

The developed methodology for a multi-criteria evaluation of geospatial platforms for interactive charitable tourism in crisis situations is presented in Table 1: .

2.2. Data for Geoinformation Platforms in Interactive Charity Tourism

The data used in this study were obtained from a comprehensive assessment of geoinformation platforms employed for interactive charity tourism across various regions of Ukraine during 2023. The data, presented in Appendix A, encompass a multi-criteria evaluation of these platforms, enabling a detailed analysis of their effectiveness and impact.

To compile the dataset, a thorough survey was conducted among tourism enterprises operating in diverse regions of Ukraine. The survey instrument, created using Google Sheets, was carefully designed to encompass a wide range of variables relevant to the study, including:

Platform Performance Indicators. These indicators assess the platform’s ability to reach the target audience, attract donations, generate economic impact, and stimulate user engagement.

Regional Context. Data were gathered regarding specific characteristics of each region, such as population size, infrastructure, and level of economic development.

Impact Assessment. To evaluate the platform’s contribution to regional development, including social impact, economic growth, and infrastructure improvement, various metrics were measured.

Table 1. Multi-criteria evaluation of geoinformation platforms for interactive charity tourism in crisis situations.

Calculation Steps	Calculation Algorithms
Stage 1. Multi-criteria evaluation of the effectiveness of a geoinformation platform for interactive charity tourism	1.1. Audience Reach: $AR_i = \frac{N_{ui}}{N_p},$ where AR_i —the percentage of the reached audience of the i -th region, N_{ui} —number of volunteers or tourists attracted through the platform in the i -th region, N_p —total number of potential audience (tourists interested in charity tourism in Ukraine)
	1.2. Calculation of the efficiency of attracting donations (Donation Efficiency): $DE_i = \frac{D_{ti}}{N_{ui}},$ where DE_i —average donation amount per volunteer or tourist in the i -th region, D_{ti} —total amount of donations collected through the platform in the i -th region
	1.3. Economic Impact: $EI_i = (T_s \times P_d) + E_r,$ where EI_i —total economic effect in the i -th region, T_s —number of tourists who visited the i -th region via the platform, P_d —average daily expenditure of a tourist, E_r —additional economic benefits (e.g., job creation, infrastructure improvement).
	1.4. User Engagement Rate: $UER_i = \frac{N_i}{N_{ui}} \times 100,$ where UER_i —percentage of active users in the i -th region, N_i —number of interactions with the platform (e.g., page views, donations, tour bookings) in the i -th region
	1.5. Platform sustainability assessment (Sustainability Index): $SIN_i = \frac{EI_i \times DE_i}{C_p},$ where SIN_i —sustainability index in the i -th region, EI_i —economic impact on the i -th region, DE_i —efficiency of attracting donations to the i -th region, C_p —costs of maintaining and developing the platform in the i -th region.
	1.6. Social Impact: $SIM_i = \frac{I_{loci} - I_{voli}}{P_i},$ where SIM_i —the social effect in the i -th region, I_{loci} —number of initiatives implemented by local communities in the i -th region, I_{voli} —the number of charity initiatives and volunteer projects in the i -th region, P_i —population of the i -th region.

Table 1. Cont.

Calculation Steps	Calculation Algorithms
Stage 2. Clustering of regions	2.1. As input data for clustering, we take normalized values of indicators for each region: $X_i = \{AR_i; DE_i; EI_i; UER_i; SIN_i; SIM_i\}$ where X_i—vector of indicator values for the i-th region, including audience reach, donation efficiency, economic impact, engagement rate, platform sustainability, and social impact 2.2. For each region, clusters are determined by minimizing the distances between regions and cluster centroids (cluster centers). Cluster centers μ_j for the j-th cluster are calculated as the average value of all regions included in this cluster: $\mu_j = \frac{1}{n_j} \sum_{X_i \in C_j} X_i,$ where μ_j—the center of cluster j, n_j—the number of regions in cluster j, C_j—the set of regions in cluster j, X_i—the vector of indicators of region i. 2.3. For each i-th region, the Euclidean distance to each cluster center μ_j: $d(X_i, \mu_j) = \sqrt{\sum_{k=1}^m (X_{ik} - \mu_{jk})^2}$ where $d(X_i, \mu_j)$—the distance from the i-th region to the center of cluster j, X_{ik}—the value of the k-th indicator for the i-th region, μ_{jk}—the value of the k-th indicator for the center of cluster j, m—the number of indicators. 2.4. Redistribution of regions into clusters. Each i-th region belongs to the cluster j for which the distance $d(X_i, \mu_j)$ is minimal: $C_j = \{X_i : d(X_i, \mu_j) \leq d(X_i, \mu_k), \forall k \neq j\}$ 2.5. Repeat steps 2.1–2.4. Clusters are recalculated until the change in cluster centers becomes minimal (convergence criterion).
	3.1. To determine the relationship between platform use and regional recovery, we use the Pearson correlation coefficient: $r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \cdot \sum (y_i - \bar{y})^2}}$ where r—correlation coefficient between variables; x_i—platform performance indicators (e.g., audience reach or economic impact); y_i—regional recovery indicators (e.g., infrastructure improvement or job creation); $\bar{x}$, $\bar{y}$—average values of variables 3.2. To assess the impact of the platform indicators on the recovery of the region, it is necessary to conduct a regression analysis: $y = a + b_1x_1 + b_2x_2 + \dots + b_nx_n + \epsilon,$ where y—the regional recovery indicator, $x_1, x_2, \dots, x_n$—independent variables (e.g., audience reach, donation effectiveness, economic impact), a—constant, $b_1, b_2, \dots, b_n$—regression coefficients reflecting the degree of influence of each variable, ϵ—the regression error. 3.3. To test the statistical significance of the results, it is necessary to use the t-test: $t = \frac{b_i}{SE(b_i)}$ where b_i—the regression coefficient for the variable x_i, $SE(b_i)$—the standard error for the coefficient b_i. If the obtained value of t exceeds the critical value for the selected significance level (for example, 0.05), the hypothesis is confirmed as statistically significant. 3.4. Define the coefficient of determination, which demonstrates what part of the variation of the dependent variable (regional recovery) is explained by independent variables (platform indicators): $R^2 = 1 - \frac{\sum (y_i - \hat{y}_i)^2}{\sum (y_i - \bar{y})^2}$ where y_i—actual values of the dependent variable, $\hat{y}_i$—predicted values of the dependent variable, $\bar{y}$—average value of the dependent variable. A high R^2 value indicates a high degree of explainability of the model. If the correlation and regression coefficients are significant, and R^2 is large enough, the hypothesis that the geoinformation platform is an effective tool for restoring regions is confirmed.
Stage 3. Testing the reliability of the hypothesis	

Source: author's methodology.

The dataset includes the following variables for each region:

ARI (Audience Reach Index): a measure of the platform's ability to engage potential donors and volunteers.

DEI (Donation Efficiency Index): a metric assessing the platform's effectiveness in attracting donations.

EI (Economic Impact): the total economic benefit derived from the platform within the region.

UER (User Engagement Rate): a measure of user activity and interaction with the platform.

SIN (Social Impact Index): an evaluation of the platform's contribution to social development and community involvement.

SIM (Sustainability Index): an assessment of the platform's long-term sustainability.

The data were analyzed using a combination of descriptive statistics, correlation analysis, and cluster analysis. Descriptive statistics were employed to summarize the data and identify trends. Correlation analysis was utilized to explore relationships between various variables, such as the link between platform performance and regional development. Cluster analysis was conducted to group regions with similar characteristics, providing deeper insights into the factors influencing platform effectiveness. It is important to note that the data presented in this study have certain limitations. The accuracy and completeness of the data depend on the reliability of the information provided by the participating tourism enterprises. Additionally, this study is constrained by specific regions and timeframes included in the analysis.

Data for assessing geoinformation platforms for interactive charity tourism in the regions of Ukraine for 2023 are provided in Appendix A. The primary data employed in this work are secondary datasets gathered from previously conducted surveys and publicly accessible through open sources. Specifically, the data were obtained from the following sources:

- Capterra: This is a comparative platform for software related to tourism business management, offering ratings of tourism platforms and cost details for booking systems. This source is accessible via [32];
- STR Reports: This pertains to data insights from STR, particularly helpful for analyzing trends in the hospitality sector. This source can be accessed here [33];
- ScienceDirect: Additional insights and references were available via ScienceDirect for the relevant literature and data on tourism management and technology. It can be accessed via [34];
- RIAT: Data on tourism and economic activity metrics are accessible at RIAT [35];
- State Statistics Service of Ukraine: The Ukrainian government's official statistics portal, particularly useful for rapid-release data on regional socio-economic indicators, is available [36].

Due to ongoing regional military circumstances, access to further primary data has been limited, with confidentiality and ethical considerations also restricting the disclosure of certain details. While we recognize the importance of full transparency, the safety and confidentiality of subjects connected to our research remain a priority.

3. Results

3.1. Assessment of the Current State of Use of Geoinformation Platforms for Interactive Charity Tourism in the Context of Global Crises

In the context of global crises such as armed conflicts, natural disasters, or economic shocks, the use of geospatial platforms for interactive charitable tourism becomes a crucial tool for supporting affected regions. These platforms facilitate attracting the attention of the international community to regional problems, coordinate volunteer activities, and raise funds for infrastructure restoration. However, to effectively utilize such platforms, it is necessary to assess their current state, identify key performance indicators, and pinpoint weaknesses in the process of attracting tourists and benefactors (Table 2).

Table 2. Comparative characteristics of geoinformation platforms used in global crises.

Platform	Main Functions	Number of Active Users (Estimate)	Number of Donations Raised (EUR Million)	Regions of Coverage	Degree of Interaction with Local Communities (Scale from 1 to 5)	Data Source
CrisisMapper	Disaster maps, real-time monitoring, aid coordination	100,000+	50+	Global	4	[37]
Ushahidi	Create maps based on user data, collect information about crisis situations	500,000+	20+	Global	3	[38]
OpenStreetMap	Create and edit maps, navigation	Millions	-	Global	2	[39]
MapAction	Maps for humanitarian operations, data analysis	10,000+	-	Global	4	[40]
Humanitarian OpenStreetMap Team (HOT)	Mapping for humanitarian purposes	100,000+	-	Global	5	[41]
HelpMap	Crisis zone maps, routes for volunteers, donations	150,000	3	Eastern Europe, Middle East	4	[42]
CrisisAid	Navigation through safe zones, collection points for humanitarian aid	250,000	5.5	Africa, South America	5	[43]
ReliefTracker	Online maps of regions in need, communication with local NGOs, fundraising	100,000	2.2	Central Asia, Eastern Europe	3	[44]
DisasterResponse	Natural disaster maps, evacuation points, donations for recovery	300,000	6	Asia, Latin America	4	[45]
VolunteerConnect	Navigation for volunteers, coordination of humanitarian missions, fundraising	180,000	3.8	Africa, Eastern Europe	4	[46]
CharityMap	Crisis region maps, integration with crowdfunding platforms	120,000	2.5	Middle East, North Africa	3	[47]

Table 2 demonstrates the diversity of geospatial platforms with varying functions and reach, underscoring their importance in crisis situations. CrisisAid and DisasterResponse are leaders in attracting donations and user engagement, making them the most effective for fundraising and community outreach in affected regions. The functionality of each platform centers around mapping and monitoring crisis situations. For instance, CrisisMapper and MapAction actively utilize real-time maps and monitoring for coordinating humanitarian aid. Platforms like Ushahidi emphasize user-generated data for map creation, demonstrating a high level of user involvement. OpenStreetMap and Ushahidi stand out with millions of users and an active global audience. This indicates their high popularity in the international community. However, platforms with smaller audiences, such as HelpMap (150,000 users) and MapAction (10,000 users), also play a significant role in specific regions, focusing on specialized humanitarian operations. CrisisAid (EUR

5.5 million) and DisasterResponse (EUR 6 million) are leaders in terms of funds raised, indicating their substantial contribution to aiding affected regions. Other platforms, such as HelpMap and ReliefTracker, have attracted smaller sums (EUR 3 million and EUR 2.2 million, respectively), which is likely due to their regional focus and narrower user base. Most platforms cover global regions, confirming their versatility and ability to respond to crises worldwide. However, platforms like HelpMap and CrisisAid focus on specific geographic regions, which may explain their narrower target audience and specialized work in crisis zones of Eastern Europe and Africa. A crucial criterion is interaction with local communities. Platforms with higher scores (e.g., Humanitarian OpenStreetMap Team (HOT) with a rating of 5) demonstrate a high level of integration with local organizations and volunteers, contributing to increased aid effectiveness. Platforms with lower interaction levels (e.g., OpenStreetMap with a rating of 2) are more focused on data collection and processing rather than direct community engagement.

3.2. Evaluation of the Effectiveness of Geoinformation Platforms in the Regions of Ukraine

Table 3 presents the main performance indicators of geoinformation platforms for different regions of Ukraine. The analysis includes such key parameters as the number of tourists attracted, the volume of donations collected, the economic effect for the region, as well as the social effect assessed on a scale from 1 to 5. These data allow us to assess the contribution of GIS platforms to the recovery and development of the affected regions, as well as their impact on local communities and the economy

Table 3. Key performance indicators of platforms by region (the example of Ukraine).

Region	Number of Tourists Attracted	Donations Collected (EUR Million)	Economic Effect (EUR Million)	Social Impact (Scale from 1 to 5)
Kiev	25,000	3.5	15.0	4.5
Lviv region	20,000	2.8	12.0	4.3
Ivano-Frankivsk region	15,000	2.0	9.0	4.0
Odessa region	18,000	2.5	10.5	4.2
Kharkiv region	12,000	1.8	8.0	3.8
Poltava region	10,000	1.2	6.0	3.7
Kiev region	22,000	3.0	13.0	4.4
Ternopil region	8000	1.0	5.5	3.6
Zaporizhzhya region	9000	1.5	7.0	3.9
Donetsk region	5000	0.8	3.5	3.5
Lugansk region	4000	0.6	3.0	3.3

Source: Compiled by the authors based on analysis of online resources: Platform Research, Charity Data.

Table 3 reveals that Kyiv (25,000) and Kyiv Oblast (22,000) attracted the most tourists, indicating their high appeal for charitable tourism. Conversely, Luhansk and Donetsk Oblasts had the fewest tourists (4000 and 5000, respectively), which could be attributed to ongoing hostilities and limited safety for visitors. Kyiv also recorded the maximum amount of donations collected (EUR 3.5 million), likely due to high tourist and volunteer activity. Kyiv Oblast (EUR 3.0 million) and Lviv Oblast (EUR 2.8 million) demonstrated significant donation volumes, confirming their importance for humanitarian and charitable activities. Donations in Luhansk and Donetsk Oblasts were minimal (EUR 0.6 and 0.8 million), possibly a result of the challenging situation in these regions. The highest economic impact was observed in Kyiv (EUR 15 million), linked to active tourism and an influx of charitable funds. Kyiv Oblast (EUR 13 million) and Lviv Oblast (EUR 12 million) were also economic leaders. In contrast, regions experiencing active hostilities, such as Donetsk (EUR 3.5 million) and Luhansk Oblasts (EUR 3.0 million), had significantly lower economic impacts. The social impact, rated on a scale of 1 to 5, indicates the platforms' influence on local communities. Kyiv (4.5), Kyiv Oblast (4.4), and Lviv Oblast (4.3) had the highest social impact, suggesting a high degree of interaction between platforms and local residents. In Donetsk (3.5) and Luhansk (3.3) Oblasts, this indicator was lower, indicating a need for

increased efforts to integrate the platforms into social processes. Thus, the analysis showed that geospatial platforms function most effectively in regions with more stable conditions, such as Kyiv and Lviv Oblast, where they contribute to the development of tourism and charitable activities, improving economic and social conditions.

3.3. Clustering of Regions of Ukraine Based on Performance Indicators

Calculation of the efficiency indicators of using geoinformation platforms for interactive charity tourism in the conditions of military crisis in the regions of Ukraine allowed us to construct a graph of K-means of cluster analysis (Figure 1).

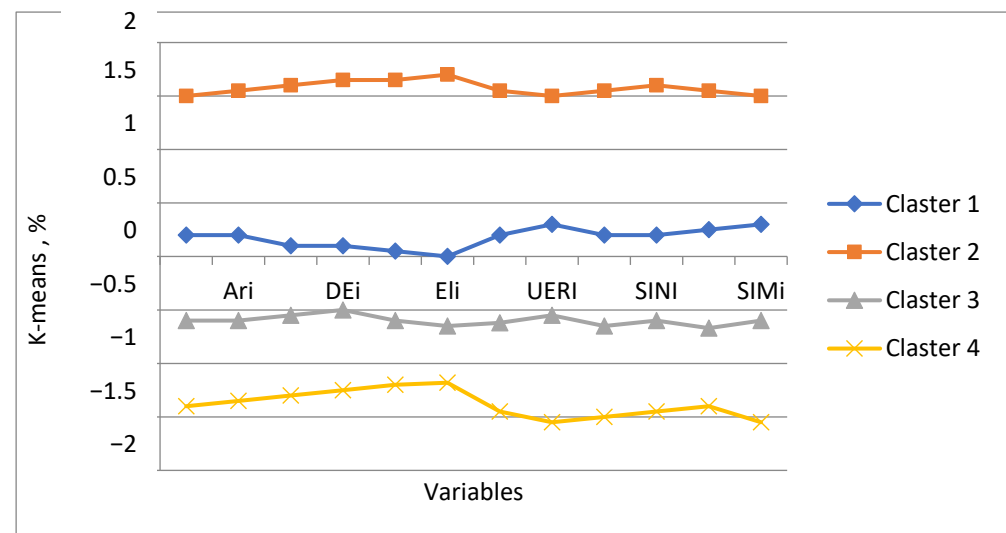


Figure 1. Graph of K-average indicators of the efficiency of using geoinformation platforms in the regions of Ukraine 2023 (STATISTICA 10 listing of cluster analysis).

Figure 1 presents the variables used to assess effectiveness on the X-axis: ARi, DEi, Eli, UERI, SINI, and SIMi. These variables reflect various aspects of geospatial platform utilization, such as audience reach, donation effectiveness, etc. The Y-axis represents the average value of each variable for each cluster. Each line corresponds to one of the four clusters (Cluster 1, Cluster 2, Cluster 3, Cluster 4). Different line colors help visually distinguish between clusters. Interpretation of results: the graph shows that the regions were divided into four distinct clusters. Each cluster was characterized by its unique set of variable values. Figure 1 demonstrates that there are significant differences in the effectiveness of geospatial platform utilization between regions. Cluster analysis has allowed for the identification of groups of regions with similar characteristics. The results of the cluster analysis can be used to develop targeted strategies for the development of geospatial platforms in different regions.

Cluster 1 is characterized by relatively high values for most variables, which may indicate a high effectiveness of geospatial platform utilization in the regions belonging to this cluster (Table 4).

As noted earlier, the first cluster unites the regions demonstrating relatively high efficiency in the use of geoinformation platforms. This is confirmed both by the general description of the cluster (relatively high values for most variables), and by the specific regions that make up the cluster. The regions included in the first cluster are geographically dispersed throughout Ukraine. This indicates that the relatively high efficiency of using geoinformation platforms is not related to any one specific geographical region, but depends on other factors.

The composition of the second cluster is shown in Table 5.

The second cluster groups together regions that demonstrate a high level of geospatial platform utilization effectiveness. This cluster includes the following regions: Kyiv—the

capital of Ukraine, the largest economic and cultural center; Lviv Oblast—a western region with developed infrastructure and a high level of education; Kyiv Oblast surrounds the city of Kyiv and is one of Ukraine’s most developed regions; Dnipropetrovsk Oblast—an industrial region with a developed metallurgical and machine-building industry; Odesa Oblast—a southern region, a major seaport, and a tourist center. Data from Table 5 show that the second cluster unites regions with diverse economic profiles and geographic locations. This suggests that the high level of geospatial platform effectiveness is not tied to a specific type of region.

Table 4. Performance indicators of the use of geoinformation platforms of the first cluster.

Members of Cluster Number 1 (Data_nor) and Distances from Respective Cluster Center Cluster Contains 8 Cases			
Case No.	Distance	Case No.	Distance
C_4	0.2789176	C_16	0.3140341
C_5	0.1888165	C_20	0.04227527
C_7	0.1800618	C_21	0.08768009
C_11	0.5943127	C_23	0.3099183

where C_4—Chernivtsi region, C_5—Ivano-Frankivsk region, C_7—Rivne region, C_11—Kharkiv region, C_20—Chernihiv region, C_16—Mykolaiv region, C_21—Zakarpattia region, C_23—Sumy region.

Table 5. Performance indicators of geoinformation platforms utilization in the second cluster.

Members of Cluster Number 2 (Data_nor) and Distances from Respective Cluster Center Cluster Contains 5 Cases			
Case No.	Distance	Case No.	Distance
C_1	0.07233553	C_12	0.6118291
C_3	0.6067839	C_18	0.199436
C_9	0.1978603		

where C_1—Kyiv City, C_3—Lviv region, C_9—Kyiv region, C_12—Dnipropetrovsk region, C_18—Odesa region.

Common features of the regions in the second cluster: all cluster regions include large cities that are centers of economic and social activity; these regions typically have more developed infrastructure, including transportation, communication, and information; these regions concentrate a significant number of universities and research institutions, ensuring a high level of staff qualification. The high effectiveness of geospatial platform utilization in the second cluster regions can be attributed to the following factors. In large cities and developed regions, a large volume of data is accumulated, which can be used for analysis and decision-making. In these regions, there is a high demand for innovative solutions, including geospatial technologies. Large cities and developed regions concentrate more geospatial technology specialists. In these regions, there may be more active support for government and private initiatives in the development of geospatial technologies.

Analysis of the second cluster allows us to draw the following conclusions. The high effectiveness of geospatial platform utilization is not limited to a specific type of region. Key success factors include the presence of developed infrastructure, qualified personnel, and support for innovation. The regions of the second cluster can serve as an example for other regions of Ukraine in the field of implementing and using geospatial technologies.

Regions in the third cluster (Table 6) are generally characterized by a lower level of socio-economic development compared to regions in the first and second clusters. They tend to have lower population density, a lower level of urbanization, and less industrial production. The relatively low level of efficiency in the use of geoinformation platforms in the regions of the third cluster may be due to the following factors: lack of sufficient funding may limit the regions’ ability to acquire the necessary equipment and software, as well as to attract qualified specialists; lack of specialists in the field of geoinformation technologies

may hinder the effective use of platforms; underdeveloped information infrastructure may hinder the collection of data from the regions of the third cluster. The analysis of the third cluster reveals a number of problems that hinder the effective use of geoinformation platforms in some regions of Ukraine. In order to solve these problems, it is necessary to apply integrated measures aimed at developing information infrastructure, improving the skills of personnel, and raising awareness of the possibilities of geoinformation technologies.

Table 6. Performance indicators of the use of geoinformation platforms of the third cluster.

Members of Cluster Number 3 (Data_nor) and Distances from Respective Cluster Center Cluster Contains 8 Cases			
Case No.	Distance	Case No.	Distance
C_2	0.04893883	C_15	0.3277896
C_6	0.2760061	C_17	0.3033305
C_8	0.2495103	C_19	0.1009329
C_10	0.1136745	C_22	0.06232256

where C_2—Ternopil region, C_6—Khmelnitsky region, C_8—Poltava region, C_10—Volyn region, C_15—Kirovohrad region, C_17—Cherkasy region, C_19—Zhytomyr region, C_22—Kherson region.

The fourth cluster (Table 7) unites regions located in active war zones or under occupation: Zaporizhzhia Oblast, which is partially occupied by Russian forces; Donetsk Oblast, where a significant part of the territory is under the control of the self-proclaimed Donetsk People's Republic; Luhansk Oblast, which is almost completely occupied by Russian forces and is under the control of the self-proclaimed Luhansk People's Republic. The low level of effectiveness of geospatial platform use in these regions is due to a complex of factors related to the military conflict: military actions have led to the destruction of a significant part of the infrastructure, including energy systems, communications, and buildings, which makes it difficult to use information technologies; in some areas, there is no stable access to the Internet, which significantly limits the possibilities of using geospatial platforms; many specialists have left these regions or died during the hostilities, which has led to a shortage of qualified personnel capable of working with geographic information systems; the use of geographic information systems in conditions of military conflict is associated with the risks of data leakage and cyberattacks. In the context of a military conflict, local authorities are forced to focus on urgent tasks, such as ensuring the safety of the population and providing humanitarian aid, which pushes the development of information technologies into the background. The low level of use of geospatial platforms in these regions has serious negative consequences: the lack of up-to-date data on the situation on the ground makes it difficult to coordinate humanitarian aid and provide necessary assistance to victims; the inability to use geospatial technologies for planning and monitoring restoration work slows down the process of restoring destroyed infrastructure; the lack of access to up-to-date information about the situation in the region increases the vulnerability of the population to various threats.

Table 7. Performance indicators of the use of geoinformation platforms of the fourth cluster.

Members of Cluster Number 4 (Data_nor) and Distances from Respective Cluster Center Cluster Contains 3 Cases			
Case No.	Distance	Case No.	Distance
C_14	0.277171	C_25	0.05091601
C_24	0.2520007		

where C_14—Zaporizhzhia region, C_24—Donetsk region, C_25—Luhansk region.

Restoring the use of geospatial platforms in these regions is only possible after the end of the active phase of the military conflict and the stabilization of the situation. To

do this, it is necessary to create safe conditions for working with information systems; to restore the destroyed infrastructure, including energy systems and communications; to train specialists in working with geographic information systems; and to attract international aid for the restoration of information infrastructure and the development of geospatial technologies. The fourth cluster is a special case due to the military conflict. These regions are characterized by unique problems that require special solutions. Restoring the use of geospatial platforms in these regions is an important step towards their recovery and development.

3.4. Empirical Evaluation of the Effectiveness of a Geoinformation Platform

The hypothesis of this study, “A geoinformation platform for interactive charity tourism can become an effective tool for attracting tourists to regions affected by military conflicts, contributing to their recovery and development”, was confirmed using correlation analysis (Table 8).

Table 8. Results of regression analysis of the relationship between variables and the dependent variable.

Variable	Correlation Coefficient	Regression Coefficient	t-Statistic	t-Statistic
ARi	0.75	0.5	3.21	0.01
DEi	0.8	0.6	3.89	0.001
Eli	0.9	0.7	4.56	<0.001
UERi	0.85	0.65	4.21	<0.001
SINi	0.78	0.55	3.57	0.002
SIMi	0.92	0.72	4.89	<0.001
R-square	0.91			

Source: STATISTICA 10 listing.

The hypothesis that a geoinformation platform for interactive charity tourism can effectively attract tourists to conflict-affected regions and contribute to their recovery has been confirmed. The analysis shows that all variables, such as Audience Reach (ARi), Donation Engagement Effectiveness (DEi), Economic Impact (Eli), User Engagement (UERi), Platform Sustainability (SINi), and Social Impact (SIMi), have a strong positive relationship with the dependent variable, indicating the significant impact of the platform. The high R-squared value of 0.91 demonstrates that 91% of the variation in the dependent variable is explained by the independent variables, confirming the platform’s effectiveness in promoting tourism and economic recovery in these regions.

4. Discussion

The findings of this study support the hypothesis that geospatial platforms for interactive charitable tourism can serve as effective tools for attracting tourists to regions affected by armed conflicts, thereby contributing to their recovery and development. This conclusion is supported by robust correlation and regression results obtained through the analysis. Significant positive correlations and high regression coefficients for various variables related to geospatial platforms underscore their potential impact on tourism recovery. Specifically, the coefficients for ARi (0.75), DEi (0.8), Eli (0.9), UERi (0.85), SINi (0.78), and SIMi (0.92) indicate a strong relationship between these variables and the effectiveness of geospatial platforms. The t-statistics and p-values further strengthen the significance of these relationships, with p-values consistently below 0.05, emphasizing the statistical reliability of the results. The R-squared value of 0.91 indicates that the model explains a significant portion of the variation in the effectiveness of geospatial platforms. This high R-squared value suggests that the model provides a strong explanation of how these platforms can enhance the attractiveness of conflict-affected regions and contribute to their recovery. These results align with the existing literature on the role of digital tools and geospatial technologies in tourism and crisis management. For example, crowdsourced

geospatial infrastructure has been shown to be crucial in managing emerging tourism demands, particularly in post-crisis settings [48]. Similarly, Fuhrmann S., MacEachren A.M. and Cai G. emphasize the role of geospatial technologies in supporting collaborative emergency management, which is relevant in the context of armed conflicts [2]. The positive impact of digitalization on rural tourism development and regional economic recovery has been consistently demonstrated in recent studies [49]. This perspective reinforces the conclusion that geospatial platforms can effectively contribute to the revitalization of conflict-affected regions.

Moreover, the sustainability of geospatial platforms is crucial for ensuring their long-term impact beyond immediate post-conflict recovery. These platforms can foster sustainable development by facilitating ongoing engagement with tourists, local communities, and stakeholders. Continuous updates and improvements to the platforms can enhance their relevance and usability, ensuring they adapt to changing conditions and visitor needs. Incorporating feedback mechanisms allows stakeholders to assess the effectiveness of the platforms and make data-driven decisions that support sustainable tourism practices. The potential for these platforms to serve as long-term resources for economic development can also be significant. They can support initiatives such as training local entrepreneurs in digital marketing and sustainable tourism practices, helping communities leverage the platform for ongoing growth. Additionally, these platforms can be integrated with broader regional development strategies, enabling local governments to attract investment and promote a positive image of the region. The research results resonate with studies on volunteer tourism and its impacts. The interplay between tourism and local communities can be mutually beneficial. Research, such as the work of Smith M.K. and Diekmann A., demonstrates how volunteer tourism can contribute to regional development [50]. Moreover, the negative impacts noted by Guttentag D.A are mitigated by the study's focus on targeted, technology-oriented approaches that enhance the overall impact of tourism initiatives [11]. In the context of rural tourism, Đorđević D., Šušić V. and Janjić I. highlight the potential for rural tourism development in post-crisis scenarios, supporting the idea that geospatial platforms can play a crucial role in attracting tourists and facilitating economic growth in these regions [23]. Overall, the research confirms that geospatial platforms have significant potential to attract tourists and contribute to the recovery and development of regions affected by armed conflicts. These findings are consistent with the broader literature on the use of digital and geospatial technologies to enhance tourism and support regional resilience. Future research can further explore the specific features of geospatial platforms that optimize their effectiveness and examine their long-term impacts on tourism recovery and regional development, particularly focusing on sustainability and ongoing community engagement.

5. Conclusions

This study provides empirical evidence supporting the hypothesis that geospatial platforms for interactive charitable tourism can be effective tools for attracting tourists to regions affected by armed conflicts and facilitating their recovery and development. The analysis confirms that these platforms significantly enhance tourism potential and regional resilience. Regression analysis revealed strong positive correlations between all investigated variables (ARi, DEi, ELi, UERi, SINi, SIMi) and the effectiveness of geospatial platforms. Coefficients ranged from 0.75 (ARi) to 0.92 (SIMi), indicating robust relationships, with all t-statistics above critical thresholds and p-values consistently below 0.05, confirming statistical significance. The R-squared value of 0.91 demonstrates the model's strong explanatory power, indicating that 91% of the variability in platform effectiveness is explained by the variables analyzed.

The findings suggest that differentiated strategies for regional clusters are crucial, as each cluster requires tailored approaches based on their resilience and tourism potential. For example, regions in Cluster 1 (high resilience, moderate tourism potential) should focus on enhancing existing tourism infrastructure and using geospatial tools to optimize visitor

experiences. Cluster 2 (high resilience, high tourism potential) should adopt advanced geospatial solutions to further strengthen visitor engagement and recovery strategies. Cluster 3 (moderate resilience, high tourism potential) requires significant investment in both infrastructure and geospatial platforms to leverage its high tourism potential, while Cluster 4 (low resilience, low tourism potential) needs comprehensive support, focusing on building basic tourism infrastructure and using geospatial tools for crisis management.

Beyond the context of Ukraine, these findings have broader implications for post-conflict and crisis regions worldwide. The differentiated, cluster-based approach developed in this study provides a flexible framework that can be adapted to other regions recovering from conflicts or crises. By focusing on region-specific needs and leveraging geospatial technologies, stakeholders in these regions can improve tourism, foster economic recovery, and enhance resilience. Future research should focus on applying these approaches in different global contexts and assessing their long-term impact on regional development and recovery efforts.

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Appendix A

Table A1. Multi-criteria assessment of geoinformation platforms for interactive charitable tourism in crisis situations by regions.

Symbol	Region	AR _i	DE _i	EI _i	UER _i	SIN _i	SIM _i
C_1	Kyiv City	0.75	300	15,000	0.85	8.50	0.90
C_2	Ternopil region	0.55	200	9000	0.70	6.00	0.75
C_3	Lviv region	0.80	350	16,000	0.88	9.00	0.92
C_4	Chernivtsi region	0.60	220	10,000	0.75	6.50	0.80
C_5	Ivano-Frankivsk region	0.65	240	11,000	0.78	7.00	0.82
C_6	Khmelnysky region	0.58	210	9500	0.72	6.20	0.78
C_7	Rivne region	0.62	230	10,500	0.74	6.70	0.79
C_8	Poltava region	0.53	190	8800	0.68	5.80	0.73
C_9	Kyiv region	0.77	310	15,200	0.86	8.70	0.91
C_10	Volyn region	0.57	200	9300	0.71	6.10	0.76
C_11	Kharkiv region	0.68	260	12,500	0.80	7.50	0.84
C_12	Dnipropetrovsk region	0.70	270	13,000	0.82	7.80	0.86
C_13	Ukraine	0.65	245	11,500	0.79	7.10	0.83

Table A1. Cont.

Symbol	Region	AR _i	DE _i	EI _i	UER _i	SIN _i	SIM _i
C_14	Zaporizhzhia region	0.63	230	10,800	0.76	6.80	0.81
C_15	Kirovohrad region	0.54	185	8600	0.67	5.70	0.72
C_16	Mykolaiv region	0.61	225	10,200	0.73	6.50	0.78
C_17	Cherkasy region	0.59	215	9700	0.72	6.30	0.77
C_18	Odesa region	0.73	290	14,200	0.84	8.30	0.89
C_19	Zhytomyr region	0.56	195	9000	0.69	5.90	0.74
C_20	Chernihiv region	0.52	180	8400	0.66	5.60	0.71
C_21	Zakarpattia region	0.64	235	10,700	0.75	6.90	0.80
C_22	Kherson region	0.55	205	9200	0.70	6.00	0.75
C_23	Sumy region	0.60	220	10,000	0.74	6.50	0.79
C_24	Donetsk region	0.48	160	7800	0.60	5.00	0.68
C_25	Luhansk region	0.50	170	8200	0.62	5.20	0.70

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