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Transportation infrastructure and sustainable tourism development: the moderation effect of Logistics Optimization "Success breeds complacency, and complacency breeds hubris?"

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Abstract:

This paper investigated the influence of Transportation infrastructure on sustainable tourism development with the moderation effect of Logistics Optimization. The paper aimed to test three alternative hypotheses: transport infrastructure has a positive significant influence on sustainable tourism development; Logistics Optimization has a positive significant influence on sustainable tourism development and Logistics Optimization has moderation positive influence on the link between transport infrastructure and sustainable tourism development. This paper is guided by resource orchestration theory and coordination theory. This is a cross-sectional study and the data were collected from work-in tourists at Ngongoro conservation area in Tanzania, where questionnaire survey was administered with the tourists and interviews were carried out with transporters. Systematic random sampling was used for tourists' participation while interview was administered with tourist vehicle drivers representing transporting agencies. The data were collected from 130 tourists and 16 drivers; the data were analyzed using structural equation modelling (SEM) with the aid of SPSS. TINF with (β= 0.3551 and P=0.0000), LOPT (β= 0.2894 and P=0.0000), and Int_1 (β= 0.1647 and P=0.0016). The findings portray positive and significant influence of TINF on STD and positive and significant influence of LOPT on STD, and LOPT showing positive and significant moderating influence on the link between TINF and STD. from the findings it is recommended that transportation infrastructure need enhancement from all the necessary dimensions and policy makers to strategically consider this important aspect of tourism and collaborate with logistics service provide for improvement and for stakeholders in tourism sector to consider a crucial aspect in tourism development. Logistics optimization in the process can automatically improve the efficiency in the link between transportation infrastructure and sustainable tourism development. Future studies may be carried out on how to enhance

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collaboration between private owned facilities and government strategic direction on improving tourism sector in Tanzania.

Keywords: Transportation infrastructure, sustainable tourism development, logistics optimization

1. INTRODUCTION

Tourism is a vital sector in developed and developing countries, it contributes significantly in economic growth, employment creation, cultural exchange, and regional development across the globe Khaksar & Amir, 2023). Reflecting from the United Nations World Tourism Organization (UNWTO) statistics, tourism accounts for about 10% of global GDP and one in every ten jobs worldwide (Nunkoo & Seetanah, 2018; Wilkinson, 2018). In Tanzania, tourism sector is a significant contributor to GDP and employment, and as an important sector it has increasingly relied on strategic transportation infrastructure in enhancing accessibility to both urban and rural tourist destinations (Mgonja, 2020).

For developing countries such as Tanzania, which hosts world-renowned tourist destinations like the Serengeti, Kilimanjaro, and the Ngorongoro Conservation Area, tourism represents a major source of foreign exchange and economic diversification. However, the sustainability of tourism development largely depends on the availability and efficiency of supporting systems, particularly transportation infrastructure and logistics management. Transportation infrastructure facilitates the physical movement of tourists and services, while logistics optimization ensures that these movements occur efficiently, reliably, and with minimal waste of time and resources.

Referencing transportation infrastructure and tourism development, Sun and Kauzen (2023) in their research stated that seaport infrastructure has a substantial impact on economic and tourism growth, the authors emphasized on the need for integrated transport and logistics policies. Since they used structural equation modeling, the findings revealed a strong link between international trade, transport infrastructure, and economic development, suggesting implications for tourism logistics. On the other respect by using optimization models for inland container depot placement in Dar es Salaam, Mwemezi and Huang (2012) provides a logistics-centric analysis and their findings illustrate how logistics efficiency can be leveraged to reduce transport costs and congestion, indirectly enhancing the tourism experience by facilitating smoother supply chains to remote tourism hubs. In the context of national parks, Mlozi and Pesämaa (2018) argue that public infrastructure knowledge strongly correlates with national park awareness and behavior. This highlights the educational and perceptual benefits of infrastructural development and logistics accessibility in ecotourism. These research studies demonstrate the need to create the link between logistics initiatives and tourism development and at the same time calls for undertaking to illustrate how logistics can be directly and indirectly linked to tourism development.

Globally, a growing body of literature has highlighted the interplay between transport systems and tourism outcomes. Scholars have underscored that transportation accessibility is a key determinant of tourism flow and that improvements in infrastructure can expand the spatial and

temporal scope of tourism activities. Yet, very few studies have examined the combined or interaction effect of logistics optimization on the relationship between transportation infrastructure and sustainable tourism development. Lopresti & Tartaglia, (2024) illustrated on high-speed rail accessibility and its influence on tourism flows in Italy, highlighting the critical role of transport infrastructure improvements in shaping tourism characteristics and the enhancement of both leisure and business tourism in urban areas. Wang et al., (2021) in their work in Hubei Province highlighted that transport accessibility significantly influences tourism efficiency with improvements in transportation facilities contributing to better tourism outcomes. Lin, (2022) emphasizes that transportation for tourists is associated with power structures and historical contexts, illustrating how revolutions in transportation have democratized travel, influenced tourism flow and enabled recently decolonized nations seeking political and economic autonomy. Murniati, (2024) on the other hand illustrated that transportation infrastructure can significantly influences tourism development from enhanced accessibility, which in turn affects visit decisions and economic welfare. Demonstrating that improved infrastructure expands tourism activities' spatial and temporal scope, ultimately benefiting both tourists and local economies.

Kisinga et al. (2024) present empirical support for the moderating role of logistics capabilities in the performance of small-scale tourism-related enterprises in Dodoma. This study emphasized how logistics optimization enhances supplier relationships, indirectly boosting sustainable tourism-related business outcomes. On the other respect on Post-COVID, Massawe et al. (2024) and Njoya (2022) revealed tourism's pivot towards digital and logistical resilience; where Massawe et al. (2024) highlighted the rising role of social media logistics in accommodation recovery, and Njoya (2022) showing how COVID-19 disruptions heightened urban-rural income disparities, all stressing logistics' role in equitable tourism revival. Lwoga (2019) further adds spatial and perceptual proximity as key moderators of tourism attitudes in heritage-rich zones. In essence improved transportation and logistics can bridge these perceptual gaps, fostering stronger community-tourism synergies. These studies here highlight the intertwined roles of transportation, logistics, and strategic planning in promoting sustainable, inclusive, and resilient tourism in Tanzania. The current study addresses this gap by investigating whether logistics optimization moderates the relationship between transportation infrastructure and tourism sustainability in the Tanzanian context. The premise is that when logistics systems are optimized, the return on infrastructure investments increases, enabling better performance in tourism outcomes such as visitor satisfaction, environmental conservation, and community engagement.

In the context of Tanzania, tourism development is both an opportunity and a challenge. Despite its rich natural and cultural heritage, the tourism sector faces limitations stemming from inadequate transportation networks, poorly maintained roads, limited air connectivity, and weak coordination among service providers. These constraints significantly hamper tourist mobility and reduce the attractiveness of key destinations. A well-functioning transportation system is thus a fundamental enabler of tourism development, influencing accessibility, destination competitiveness, and tourist satisfaction. Road, air, rail, and even marine transport services form the lifelines connecting domestic and international tourists to Tanzania's major tourist circuits. However, infrastructure alone is not sufficient. Without strategic logistics planning and

coordination, investments in transportation may fail to deliver the intended developmental outcomes.

2. LITERATURE REVIEW

2.1 Theoretical Underpinning:

The theoretical foundation of this study is extracted from Resource Orchestration Theory (ROT) and Coordination Theory. In this respect, ROT posits that it is just the possession of resources (e.g., infrastructure) that matters, but an extended implication as on how the resources are bundled, deployed, utilized and coordinated for the purpose of achieving the strategic objectives. In this context, transportation infrastructure is positioned as a strategic resource, and on the other side logistics optimization represents the orchestration mechanism. On the aspect of coordination theory, the emphasis is given on the interdependence of tasks and the importance of aligning processes to achieve system-level efficiency, safe in the knowledge in tourism that some aspects of logistics (i.e. transportation of tourists) is taken by private sectors and aspect of infrastructure is controlled by the government. The synergy between transport and logistics, as conceptualized in these theories, is expected to enhance tourism performance when effectively coordinated.

2.1.1 Resource Orchestration Theory (ROT)

Resource Orchestration Theory (ROT) has emerged and discussed as a valuable framework for understanding and managing tourism. It emphasizes the critical aspect of strategically structuring, bundling, and leveraging resources for the creation of competitive advantages (Peuscher, 2016). In tourism contexts, application of ROT can be attributed to the development of destination product portfolios though orchestrating different attractions and tourism types (Ersoy, 2019). This approach involves the usage of analytical techniques for example the analytical hierarchy process and interpretive structural modeling onto mapping interconnections between tourism offerings (Ersoy, 2019). On the other hand, ROT also plays an important role in collaborative innovation networks within tourism destinations. Successful orchestration of these networks and collaborations is associated with building trust, ensuring coordination of resources, infrastructural development, knowledge mobility, shared ownership, and network stability (Milwood & Roehl, 2018). By applying ROT, tourism manager, government and authorities can enhance destination competitiveness, sustainability, and innovation capabilities (Milwood & Roehl, 2018).

2.1.2 Coordination Theory

Recalling from Messori & Volo, (2024), coordination theory in tourism, as explored in their paper emphasized on the multidimensional nature of coordination among tourism firms. This paper managed to identify four main thematic areas: antecedents, enablers, actions, and outcomes. The study highlighted that effective coordination involves personal and business interactions, response strategies, interorganizational relationships, and formal agreements. So in this context, through

improved coordination practices, this theoretical framework serves as a foundation for understanding how tourism firms can enhance competitiveness and adapt to market changes. Also referencing from Chen, (2014), coordination theory is illustrated to being derived from synergetics theory, in that it is utilized in tourism for the notion of analyzing and understanding that there are interrelationships and dynamics within tourism systems. In this specific paper by Chen, (2014), the research paper helps assess the coordination condition of tourism development at the provincial level in China and established a model that incorporates tourism supply, demand, and support sub-systems, revealing significant improvements in coordination among provinces over 15 years. According to the paper by Figini, (2022), narrated that coordination theory in tourism also tend to emphasize the importance of stakeholder collaboration for effective destination management. This paper by Figini, (2022) posited that both destination management and tour operators can enhance welfare through improved coordination, which can lead to better local development outcomes. According to the contribution by Marques, (2016), as the author discusses coordination theory in tourism through a game theory model that analyzes the optimal capacities of transport and tourism, the paper highlighted the relationship between the type of tourism, characterized by the length of stay and transport duration, and the installation costs of both sectors. The findings by Marques, (2016) emphasized on the importance of balancing installation costs and durations to achieve effective capacity coordination in tourism.

2.2 Empirical review

2.2.1 Sustainable Tourism Development:

Sustainable tourism in this context is grounded in the principles of environmental conservation, social equity, and economic viability, which is emerged as a critical paradigm in the tourism industry. Sustainable tourism seeks to harmonize the needs of tourists, host communities, and the environment and in the global picture researchers emphasizes on the need to move from conceptual goals to actionable pathways in sustainable tourism. According to Niewiadomski and Brouder (2024), the authors argue for embracing the "sustainability transitions" framework, which reorients tourism as a socio-technical system that require systemic transformation and innovation. Miller and Torres-Delgado (2023) on the other hand reviewed sustainable tourism indicators, cautioning against excessive reliance on metrics that may obscure broader sustainability goals. In terms of practical implementation, Kusumastuti et al. (2024) proposed to leverage local value in "post-smart" tourism villages to ensure authenticity and community participation and Peeters et al. (2024) who emphasized on climate mitigation strategies as integral to sustainable tourism research.

In Africa, sustainable tourism literature is mostly framed within local development and post-COVID recovery, for instance eMuresherwa et al. (2024) highlighted community-based and eco-tourism initiatives in Southern Africa being the vehicles for resilience and sustainability post-pandemic and Mtapuri et al. (2023) provide a continental overview, showing how tourism aligns with Sustainable Development Goals, this explains that more research is needed beyond these lines. Shifting focus specifically in Tanzania, Haulle (2019) managed to investigate the socio-political dynamics of tourism in Ngorongoro, the author reveals how displacement and resource alienation undermine sustainability. And in a more constructive vein, Bakari et al. (2024)

documented how cultural heritage tourism empowers local communities economically while preserving identity, particularly in sites like Serengeti and Bagamoyo and Mollel (2024) who advocated for coordinated expedition planning and policy reforms to strengthen sustainability initiatives. Overall, the literature here also suggests that sustainable tourism requires not only robust policy and measurement tools but also a bottom-up commitment to community empowerment, environmental stewardship, and adaptive governance. Considering that Tanzania being situated at the nexus of ecological richness and socio-cultural diversity, this offers both challenges and unique opportunities for embedding sustainability in tourism development.

2.2.2 The Role of Transportation Infrastructure in Tourism Development

In this context, transportation infrastructure is conceptualized as fundamental to economic integration, social mobility, and environmental sustainability. It should be noted that globally, this sector is evolves responding to urbanization, climate change, and digital innovation, while at the same time African nations face several constraints like underinvestment, capacity gaps, and environmental fragility. In developed economies, Ivanková et al. (2021) found a positive correlation between road infrastructure and various forms of tourism spending across OECD countries and Kanwal et al. (2020) highlighted how perceived benefits from road development increase community support for tourism, reinforcing the socio-economic value of inclusive infrastructure planning. In Tanzania, for example, it should also be noted that infrastructure plays a strategic role in unlocking tourism linkages. From the literature, at the global level, for example Liu et al. (2022) assessed the risks that global warming poses to transportation infrastructure, the authors highlighted that nearly 88.4% of global road and rail assets will be exposed to intensified precipitation by mid-century and advocated for adaptive design protocols to mitigate infrastructure vulnerability.

Further to that, Kang (2023) argues that transport infrastructure is crucial for regional integration in Africa and illustrated that high-quality roads and ports enhance trade facilitation and enables the formation of regional markets, fostering deeper economic interdependence. Similarly, Calderón et al. (2018) in their paper revealed that infrastructure gaps in Sub-Saharan Africa significantly constrain growth potential, which called for blended financing models to mobilize the needed capital. In South Africa, Hlotywa and Ndaguba (2017) managed to establish strong positive correlation between road transport investment and economic development, this underscored infrastructure's long-run growth effects. In contrast, Nyasha and Odhiambo (2024) cautioned that such impacts manifest only in the long term and stressed on the importance of sustained policy commitment. Hetisani (2014) explores how corridor-based transport planning in South Africa's Phalaborwa sub-corridor facilitates strategic tourism development, narrating how essential transport planning is to tourism development. Florido-Benítez (2024) extends this by linking improvements in air transport security with increased tourism demand across African countries, stressing that transportation efficiency and safety are crucial for sustaining inbound tourism flows, being quite essential to tourism sustainability. Region-specific studies like those by Zhang (2022) address the dual impact of transport and tourism on carbon emissions, pushing for sustainable, low-carbon transport solutions in eco-tourism hubs.

Zooming into Tanzania, Kauzen et al. (2020) employ structural equation modeling to confirm a significant impact of transport infrastructure on the growth of GDP. The authors advocated for robust public-private partnerships to overcome financing bottlenecks. Furthermore, Sun and Kauzen (2023) reinforce this by analyzing seaport infrastructure and economic linkages and the authors showed how ports are pivotal to trade and low-cost goods movement. On oter respect Robinson (2021) presented a systems-level view by developing Tanzania's Transportation Infrastructure Management System (TIMS), this is aimed at optimizing network connectivity, population flows, and multimodal transport. Meanwhile, Bengesi et al. (2016) examined the complexities of PPPs in Tanzanian transport, the authors highlight policy, regulatory, and coordination gaps. Turning sides, which also explains the dependability between tourism development and transport logistics, Mwipopo and Massawe (2024) present compelling evidence that tourism can stimulate improvements in transportation and public utilities in rural conservation areas. Their study by Mwipopo and Massawe (2024) was conducted in Karatu District, whohc typically illustrate how tourism inflows indirectly drive investment in road networks, that enhance both the tourist experience and local livelihoods.

Complementing the above, Macha (2021) finds that trust in transport services can significantly influence domestic tourism participation, this underlined the importance of reliable infrastructure in fostering local tourism engagement. Overall, in all these connotations, transportation infrastructure remains as a critical enabler for tourism development. The effectiveness transportation infrastructure lies not only in physical connectivity but also in aligning with environmental, technological, and socio-economic objectives across global and local contexts. In such a reference, transportation infrastructure being a cornerstone of tourism development, enhancing accessibility, mobility, and economic integration - robust transport systems (road, air, and maritime) are essential for facilitating the flow of tourists and optimizing destination competitiveness. In this digital era, Liu and Huang (2025) show that transportation infrastructure can significantly amplify the impact of the digital economy on tourism growth by attracting online tourist attention, portraying a synergistic relationship between digital connectivity and physical accessibility.

2.2.3 Logistics optimization

According to Hu, (2024), logistics optimization involves improving the efficiency and effectiveness of the logistics supply chain. Logistics optimization involves enhancement of transportation, warehousing, packaging, inventory, and information management to minimize costs and improving operational efficiency (Andru, 2024). The effectiveness in logistics practices significantly boost organizational performance, customer satisfaction, and competitive advantage (Andru, 2024). Ma, (2022) postulated that logistics optimization enhances economic growth for logistics and transportation enterprises by simplifying process management and improving system operations. With respect to logistics and tourism, Vucetic, (2011) illustrated that logistics management aids in optimizing all flows within a tourist destination, enhancing destination management effectiveness and it satisfies visitor demand while improving the quality and satisfaction of tourism products, crucial for sustainable tourism growth.

On the other instance, Subkhan et al., (2024) stated that logistics is essential for sustainable tourism and enhances resource management, and fosters conservation efforts, exemplified by the development of new sea routes in Indonesia's conservation areas. According to Merkulov et al., (2022) illustrated that logistics in sustainable tourism involves optimizing material, information, and financial flows while ensuring effective planning, control, and coordination, and also enhances economic sustainability and efficiency, allowing tourism enterprises to adapt to diverse technological and organizational challenges. Concurrently, ЖУКОВСКАЯ & ОВЧИННИКОВ, (2024) highlighted the interdependence of logistics components, such as transportation and supply chains, which are crucial for sustainable tourism. ЖУКОВСКАЯ & ОВЧИННИКОВ, (2024) also stated that effective logistics management enhances service delivery and minimizes environmental impacts, supporting the growth of the tourism industry despite external challenges.

On the other instance, Junton & Kamthornphiphatthanakul, (2023) in their research focuses on tourism logistics management in Songkhla province, emphasizing components like Financial Flow, Physical Flow, and Customer Service, which enhance logistics efficiency, satisfaction, and loyalty, indirectly supporting sustainable tourism through improved management of tourist attractions. Logistics optimization in this context refers to the systematic planning and execution of the movement and storage of goods, services, and people. In the tourism context, this definitely entails synchronizing transport schedules, improving route planning, coordinating bookings, and managing flows of information and service delivery across different stages of the tourist experience. Efficient logistics in this respect is crucial in reducing operational bottlenecks, enhancing the reliability of transportation services, and ultimately supporting a seamless tourist journey. Moreover, logistics optimization also supports sustainability objectives through the reduction resource consumption, minimization carbon footprints, and enhancement of operational resilience. These factors are essential to achieving sustainable tourism development—defined as tourism that meets the needs of present tourists and host regions while protecting and enhancing opportunities for the future.

2.3 Hypotheses development

2.3.1 Transportation infrastructure and sustainable tourism development

In this context of t**ransportation infrastructure and sustainable tourism development**, Pachaury, (2024) postulated that transportation systems are crucial for sustainable tourism development, as highlighted in the study. This study added that effective transportation infrastructure aids in minimizing environmental impact, optimizing resource conservation, and integrating eco-friendly technologies, contributing to the overall sustainability of tourism destinations and enhancing their resilience. With the same understainf, Nag & Sarkar, (2024) narrated that transportation infrastructure is crucial for sustainable tourism development, illustrating that it enhances accessibility and connectivity. The research by Nag & Sarkar, (2024) integrates transportation with economic health and tourism, forecasting demand and promoting sustainable practices aligned with the Sustainable Development Goals, particularly in heritage sites like Bishnupur. On the other respect supporting it, Wu et al., (2021) illustrated that, transportation infrastructure promotes sustainable tourism development by enhancing residents' consumption

structures and increasing expenditures on leisure tourism, which contribute to sustainable economic growth through both direct and indirect effects on tourism consumption. Further to that, (Tan & Ismail, (2020), stated transportation infrastructure significantly influences sustainable tourism development by affecting tourist satisfaction and mobility. The availability and quality of transport modes impact tourist movement and accessibility to attractions, highlighting the need for improved transport systems to support sustainable urban tourism. These literatures entice the testing of the narrations in developing countries context where transportation is not well strategized as a tool to improve the tourism sector, as such this study developed the below hypothesis as the first hypothesis of the study:

H_1: transportation infrastructure significantly positively influences sustainable tourism development

2.3.2 Logistics Optimization and sustainable tourism development

In this context of logistics Optimization and sustainable tourism development Bentalha, (2023) postulated that sustainable logistics management in tourism enhances environmental performance by promoting coordinated and collaborative logistics practices. Bentalha, (2023) added that optimization can lead to improved efficiency in the supply chain, supporting long-term economic, environmental, and social stability within the tourism industry. On the other instance, Mishra et al., (2024) in their paper narrated that efficient logistics and supply chain practices enhance sustainable tourism development by improving service quality, reducing operational costs, and increasing customer satisfaction. Mishra et al., (2024) added that coordination among transportation, accommodation, and local suppliers fosters economic benefits for communities, promoting overall tourism growth. According to Vucetic, (2011), logistics optimization in tourism enhances destination management by efficiently organizing all flows, thereby improving visitor satisfaction and quality of tourism products. This approach, as propounded by Vucetic, (2011) is aligned with sustainable development principles, by ensuring that tourism consumption respects environmental and social capacities of the destination. Theppitak, (2018), explains that logistics optimization is crucial for sustainable tourism development by enhancing transport networks and infrastructure, reducing environmental impact, and managing resources efficiently. Siriwardena et al., (2023) extended this narration by Theppitak, (2018), explaining that logistics optimization being crucial for sustainable tourism development by ensuring efficient transportation, procurement, and delivery of quality tourism supplies, which ultimately enhances guest satisfaction and promotes sustainable performance within the tourism industry while minimizing environmental impacts. These literatures entice the testing of the narrations in developing countries context where logistics optimization is not well strategized as a tool to improve the tourism sector, as such this study developed the below hypothesis as the second hypothesis of the study:

H_2: logistics Optimization significantly positively influences sustainable tourism development

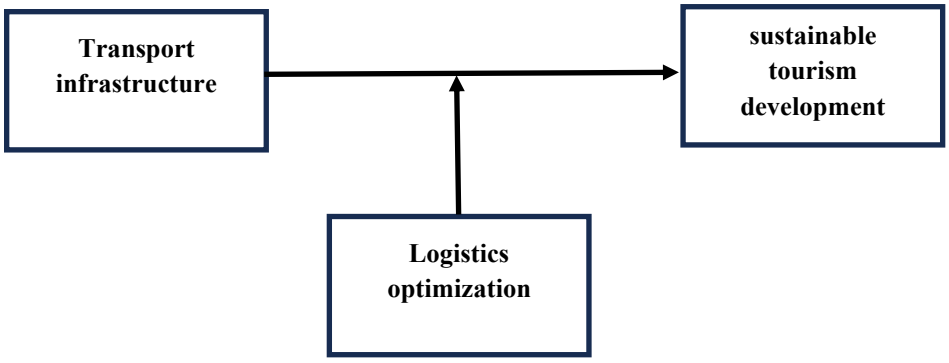
2.3.3 Transportation infrastructure, sustainable tourism development and logistics Optimization

In building the understanding between transportation infrastructure, logistics optimization and sustainable tourism development, Bai et al., (2014), tried to discuss on an integrated modeling framework for optimizing transportation infrastructure and tourism investment, where the authors emphasized on the need for strategic planning to support sustainable tourism development while addressing logistics through a bilevel optimization model that minimizes system costs under traffic congestion. On other respect Bentalha, (2023) illustrated that that sustainable logistics practices in tourism, including optimized transportation infrastructure, enhance environmental performance. Bentalha, (2023) added that coordinated and collaborative logistics resources are crucial for achieving efficiency and supporting sustainable tourism development within the industry. On the other respect Gruchmann et al., (2019) their paper focused on optimizing logistics infrastructure for sustainable local food distribution networks, they emphasized on the integration of optimization and simulation techniques to enhance decision-making, which can be applicable to transportation infrastructure in sustainable tourism development. Also, according to Nag & Sarkar, (2024), this paper integrates transportation infrastructure with tourism demand forecasting, emphasizing its role in sustainable tourism development. Nag & Sarkar, (2024) highlights the need for optimized logistics to enhance economic growth, job creation, and resilient infrastructure, aligning with Sustainable Development Goals. There's limited understanding and contribution with respect to integrating logistics optimization as a moderation on the link between transportation infrastructure and sustainable tourism and definitely the critical sense of optimizing logistics for the purpose sustainable tourism development in developing nations, that is why this current paper developed and tested the hypothesis stated below:

H_3: logistics Optimization moderates the link between transportation infrastructure and sustainable tourism development

2.4 Conceptual framework

Figure 1: Conceptual framework



Source: Researcher own construction, (2025)

3. METHODOLOGY

This study adopted a quantitative, cross-sectional research design rooted in the positivist paradigm to examine the influence of transportation infrastructure (TINF) and logistics optimization (LOPT) on sustainable tourism development (STD). A stratified random sampling technique ensured representative data from various groups, with a sample size of at least 200 respondents determined using a-priori sample size for structural equation models. For a-prior calculation used anticipated effect size of 0.2, desired statistical power level 0.5, number of latent variables 3, number of observed variables 11 and probability level (0.05), where the recommended minimum sample size was 163, so the sample size of 200 used in the study is adequate for SEM. With a focus on Tanzania's Ngorongoro Conservation Area—a prime tourist destination facing accessibility and logistics challenges—the study provides a grounded analysis of how infrastructure and logistics interact to shape tourism outcomes. Data were collected from tourists and transport service providers to capture both demand- and supply-side perspectives.

The study used questionnaire for data collection that consisted of closed-ended questions measured on a five-point Likert scale, developed by research by adopting validated elements for the presented latent and observed variables. TINF was measured by indicators such as road, air, and rail infrastructure quality and accessibility; LOPT was assessed through logistics coordination and efficiency metrics; and STD was evaluated using indicators of economic, environmental, and socio-cultural sustainability. The questionnaire was pre-tested for clarity and internal consistency, and ethical standards—such as informed consent, confidentiality, and voluntary participation—were strictly observed.

Collected data were analyzed using SPSS, with Structural Equation Modeling (SEM) applied to test the hypothesized relationships among variables. This study utilizes structural equation modeling (SEM) to statistically examine the relationship between transportation infrastructure, logistics optimization, and sustainable tourism development. SEM allows for the testing of direct, indirect, and moderating effects, making it suitable for validating complex models involving latent constructs. The analysis began with the measurement model assessment to confirm construct validity and reliability using Cronbach's Alpha, Average Variance Extracted (AVE), and Composite Reliability. Discriminant validity was checked using the Fornell-Larcker criterion. The structural model tested the direct and moderating effects of TINF and LOPT on STD, with statistical significance assessed through path coefficients, t-values, and p-values via bootstrapping. While the cross-sectional design limits causal interpretation, the rigorous methodology and use of validated instruments provide strong support for the study's findings.

3.1 Measurement of Variables

Table 1. Measurement of Variables and elements considered

S/N	Latent variables	Observed Variables	Measurement in questionnaire
1	Transport infrastructure (TINF)	Accessibility, comfort, safety, connectivity and transport service quality (Murniate and Wenzano, 2024)	5-point likert scale [1- strongly disagree (SD), 2- Disagree (D), 3- Neutral (N), 4 - Agree (A) and 5- Strongly Agree (SA)]
2	Logistics optimization (LOPT)	Transport optimization, supply chain management, technology intergration (Arkhirson *et al.,* 2025)	5-point likert scale (1-SD, 2- D, 3-N, 4 -A and 5-SA)
3	Sustainable tourism development (STD)	Long term viability, positive visitor experience, and responsible tourism (Arkhirson *et al.,* 2025)	5-point likert scale (1-SD, 2- D, 3-N, 4 -A and 5-SA)

Source: Researcher own construction, (2025)

4. FINDINGS AND DISCUSSION

4.1 Measurement Results: Level of Agreement and Descriptive Statistics

The level of agreement in table 2 above presents the percentage distribution of respondents' opinions across five key established constructs (latent variables): transport infrastructure (TINF), logistics optimization (LOPT), and sustainable tourism development (STD). The distribution here highlights the relative perceptions of stakeholders, revealing critical insights into the adequacy and effectiveness of existing systems. In the case of TINF, the responses in the table indicate a relatively high level of agreement with the observed variables such as accessibility, comfort, safety, connectivity, and transport service quality. The percentages show that a majority of respondents either agreed or strongly agreed with the adequacy of infrastructure in their context. The findings suggests that the physical and service dimensions of transport are generally perceived positively, though the distribution also indicates that a minority of respondents expressed disagreement. Such divergent opinions may reflect regional disparities, maintenance challenges, or uneven policy implementation, which aligns with literature stressing the persistent infrastructural gaps in developing economies (Murniate & Wenzano, 2024).

In the case of LOPT, the responses reflect mixed perceptions. Considering that a substantial proportion of participants reported agreement or strong agreement with transport optimization, supply chain management, and technology integration, there is a noticeable segment remained neutral or disagreed. This specific finding highlights ongoing constraints in achieving seamless optimization, specifically concerning technology integration. Arkhirson et al. (2025) made an establishment that that technological readiness and investment are critical enablers of optimization, yet barriers such as high implementation costs, limited expertise, and institutional inefficiencies

remain. In such a case, the observed distribution mirrors global findings, particularly in emerging economies where digital transformation is still evolving.

Table 2: Level of Agreement (Likert Distribution, % of Responses)

Latent Variable (LV)	Observed Variable (OV)	Statement	SA (%)	D (%)	N (%)	A (%)	SA (%)
TINF	TINF_1	Transport infrastructure in this area is easily accessible to users.	2%	5%	18%	42%	33%
	TINF_2	The available transport facilities provide adequate comfort to passengers.	3%	6%	20%	40%	31%
	TINF_3	Transport systems in this area are safe and reliable for travelers.	1%	4%	15%	44%	36%
	TINF_4	Transport infrastructure ensures good connectivity between key destinations.	2%	3%	14%	41%	40%
	TINF_5	The overall quality of transport services meets the needs of users.	2%	5%	16%	43%	34%
LOPT	LOPT_1	Transport operations in the supply chain are well optimized to reduce costs and time.	2%	5%	18%	39%	36%
	LOPT_2	Our logistics system ensures effective supply chain management.	1%	4%	15%	41%	39%
	LOPT_3	Technology is effectively integrated into logistics operations to enhance efficiency.	2%	6%	17%	38%	37%
STD	SLD_1	Tourism activities in this area are designed to ensure long-term environmental and economic viability.	1%	3%	13%	42%	41%
	SLD_2	Tourism services provide a positive and satisfying experience to visitors.	2%	4%	14%	39%	41%
	SLD_3	Tourism practices in this area promote responsibility towards society and the environment.	1%	4%	12%	40%	43%

In the case of sustainable tourism development, the distribution demonstrates stronger levels of agreement compared to logistics optimization. Majority of the respondents acknowledged the importance of long-term viability, positive visitor experience, and responsible tourism practices,

showing recognition of sustainability as a key developmental priority. However, the data also suggest that some stakeholders remain undecided, reflected in neutral responses. This aligns with the argument that while sustainable tourism principles are widely endorsed, actual implementation and adherence vary depending on resource availability, institutional frameworks, and stakeholder commitment. The findings resonate with international discourses that stress the tension between economic imperatives and sustainable practices (Arkhirson et al., 2025).

Table 3. Descriptive Statistics for Observed Variables (Mean and SD)

LV	OV	Mean (M)	Standard Deviation (SD)	Skewness	Kurtosis
TINF	TINF_1	3.99	0.88	-0.91	0.89
	TINF_2	3.90	0.92	-0.99	1.11
	TINF_3	4.09	0.84	-0.73	0.54
	TINF_4	4.14	0.83	-0.94	0.77
	TINF_5	4.02	0.87	-0.85	0.65
LOPT	LOPT_1	4.02	0.89	-0.70	0.41
	LOPT_2	4.09	0.85	-0.64	0.38
	LOPT_3	4.01	0.90	-0.88	1.27
STD	SLD_1	4.19	0.82	-0.75	0.66
	SLD_2	4.15	0.84	-0.82	0.72
	SLD_3	4.20	0.81	-0.91	0.89

The Descriptive Statistics table 3 above provide a critical insight into the central tendency and variability of the observed variables, namely accessibility, comfort, safety, connectivity, transport service quality, transport optimization, supply chain management, technology integration, long-term viability, positive visitor experience, and responsible tourism. As this analyzes the mean and standard deviation (SD), the table highlight both the overall level of agreement and the degree of consensus among respondents. In the case of TINF, the mean scores range from approximately 3.8 to 4.2, this suggest that respondents generally agree with the adequacy of infrastructure services. The highest mean was observed for transport service quality ($M \approx 4.2$), followed by connectivity and safety, indicating that respondents perceive tangible improvements in these areas. However, the standard deviation values, mostly around 0.6–0.8, this reveals moderate variability, implying that while most of the respondents recognize infrastructural progress, some remain skeptical, likely due to uneven service provision. These findings are consistent with earlier research (Murniate & Wenzano, 2024), which highlighted disparities between urban and rural infrastructural access.

In the other aspect of LOPT, mean values are clustered around 3.7 to 4.0, this suggests a generally favorable perception but with less consistency than infrastructure. Supply chain management scored relatively high, which indicate recognition of ongoing efforts to streamline operations. However, technology integration showed a slightly lower mean and higher SD, this suggests greater variability in respondents' experiences. This specific pattern underscores the

reality that digital technologies are not uniformly accessible or effectively adopted across all stakeholders. As Arkhirson et al. (2025) argued, while logistics optimization remains a global goal, institutional readiness and investment levels strongly shape its effectiveness.

Furthermore, for the case of STD, this displayed relatively high mean scores across all indicators (around 4.0–4.3), reflecting respondents' strong endorsement of sustainability principles. Positive visitor experience recorded the highest mean, indicating recognition of improved service delivery and customer satisfaction in tourism-related activities. Long-term viability and responsible tourism also performed strongly, but standard deviations near 0.7 highlight that while many participants are optimistic, others remain cautious about the full realization of sustainability goals. These findings align with the growing discourse that sustainable tourism is increasingly embraced but still faces operational challenges due to governance and resource constraints.

Furthermore, for the case of skewness, the analysis of skewness across the observed variables indicates that all values are negative, this alone suggest that responses are slightly skewed to the left. The implication here is that a majority of respondents tended to agree or strongly agree with the statements, leading to clustering of scores at the higher end of the scale. According to George and Mallery (2010), skewness values within the range of ±2 are considered acceptable in establishing univariate normality. Similarly, Byrne (2016) emphasizes that slight deviations in skewness are common in behavioral studies and do not undermine the validity of subsequent parametric statistical tests. In the case of kurtosis, the results show that all variables have positive values, though none exceed the threshold of ±3. This suggests that the distributions are moderately leptokurtic, characterized by a sharper peak around the mean compared to a normal distribution. In practice, this indicates a high degree of consensus among respondents, with most ratings concentrated around the average rather than being widely dispersed. As Kline (2015) asserts, kurtosis values between -3 and +3 are generally acceptable for maintaining normality assumptions in multivariate analysis. The observed results therefore reinforce the reliability of the measured constructs and support their suitability for advanced inferential analysis, including regression and structural equation modeling.

4.1 Confirmatory Factor Analysis Results

Table 4 above presents the results of the measurement model assessing reliability and validity for the constructs used in the study—Transport Infrastructure (TINF), Logistics Optimization (LOPT), and Sustainable Tourism Development (STD). All three constructs show Average Variance Extracted (AVE) values above 0.5, indicating good convergent validity, meaning that the items within each construct effectively measure the same underlying concept. Additionally, the Cronbach's Alpha values range from 0.842 to 0.860, and Construct Reliability (CR) values range from 0.872 to 0.886, all exceeding the recommended threshold of 0.7. These results confirm that the constructs are both internally consistent and statistically reliable, making them suitable for further structural equation modeling analysis.

Table 4. Factor Loadings, AVE, model reliability and validity

Construct	Item	Factor Loadings	AVE	Cronbach's Alpha	Construct Reliability
Transport Infrastructure (TINF)	TINF_1	0.782	0.620	0.852	0.877
	TINF_2	0.801			
	TINF_3	0.765			
	TINF_4	0.845			
	TINF_5	0.832			
Logistics Optimization (LOPT)	LOPT_1	0.784	0.610	0.842	0.872
	LOPT_2	0.798			
	LOPT_3	0.781			
Sustainable Tourism Development (STD)	SLD_1	0.795	0.635	0.860	0.886
	SLD_2	0.823			
	SLD_3	0.812			

Source: Data analysis by researcher, (2025)

4.2 Discriminant Validity

Table 5 above evaluates discriminant validity using the Fornell-Larcker criterion, which ensures that each construct in the model is empirically distinct from the others. The diagonal values represent the square roots of the Average Variance Extracted (AVE) for each construct—LOPT (0.781), SLD (0.797), and TINF (0.787)—and are all higher than the corresponding off-diagonal correlation values in their respective rows and columns. This indicates that each construct shares more variance with its own indicators than with other constructs, thereby satisfying the Fornell-Larcker criterion. Consequently, the results confirm that Transport Infrastructure (TINF), Logistics Optimization (LOPT), and Sustainable Tourism Development (SLD) are conceptually and statistically distinct from one another, supporting the model's discriminant validity

Table 5. Discriminant Validity

	CR	AVE	MSV	MaxR(H)	LOPT	SLD	TINF
LOPT	0.872	0.610	0.290	0.889	**0.781**		
SLD	0.886	0.635	0.320	0.901	0.538***	**0.797**	
TINF	0.877	0.620	0.320	0.894	0.447***	0.566***	**0.787**

Source: Data analysis by researcher, (2025)

4.3 The structural model results

Table 6 above presents the structural model results, revealing significant and positive direct effects of Transport Infrastructure (TINF) and Logistics Optimization (LOPT) on Sustainable Tourism Development (STD), with path coefficients of $\beta = 0.3551$ ($p < 0.001$) and $\beta = 0.2894$ ($p < 0.001$), respectively. This indicates that improvements in both transportation infrastructure and

logistics processes independently contribute to sustainable tourism outcomes. Additionally, the interaction term (TINF × LOPT) is statistically significant (β = 0.1647, p = 0.0015), confirming a moderating effect—logistics optimization strengthens the positive influence of transportation infrastructure on tourism sustainability. The model's R-squared value of 0.5800 implies that the combined effects of these variables explain 58% of the variance in sustainable tourism development, reflecting a robust model fit commonly accepted in behavioral and social sciences.

Table 6. The structural model results

Term	Coeff	SE	T	P	LLCI	ULCI
Constant	3.1348	0.0452	69.3571	0.0000	3.0457	3.2239
TINF	0.3551	0.0591	6.0058	0.0000	0.2392	0.4710
LOPT	0.2894	0.0624	4.6378	0.0000	0.1673	0.4115
Int_1	0.1647	0.0510	3.2275	0.0015	0.0643	0.2651

Source: Data analysis by researcher, (2025)

The study reveals that Transportation Infrastructure (TINF) plays a significant role in enhancing Sustainable Tourism Development (STD), confirming that well-developed and efficient transport systems are essential for promoting accessible, inclusive, and environmentally responsible tourism. The path coefficient between TINF and STD (β = 0.3551, p < 0.001) indicates a strong and statistically significant direct influence, suggesting that improvements in roads, airports, and related facilities create a more reliable and enjoyable experience for tourists, thereby supporting the growth of sustainable tourism. In addition to this direct relationship, Logistics Optimization (LOPT) also demonstrates a significant independent effect on STD (β = 0.2894, p < 0.001), highlighting its critical role in enhancing service delivery, reducing delays, improving coordination, and minimizing environmental impact across tourism-related supply chains. Importantly, the study further reveals that LOPT positively moderates the relationship between TINF and STD (β = 0.1647, p = 0.0015), meaning that the influence of transportation infrastructure on sustainable tourism becomes even stronger when logistics operations are effectively optimized.

According to the study by Murniati, (2024), this study examines the impact of transportation infrastructure on tourism development, analyzing factors influencing visit decisions and economic welfare improvement, highlighting the significance of infrastructure investments in promoting tourism growth and local economic development. The study revealed significant positive effects of Transportation Infrastructure and Logistics Optimization on Sustainable Tourism Development. Also Dinu, (2018), the paper emphasizes that transportation development is crucial for tourism growth, highlighting that improved transport infrastructure and logistics optimization significantly enhance tourism outcomes, with logistics processes moderating the positive effects of transportation on sustainable tourism development. According to Radushinskaya & Chernomorets, (2023), The paper emphasizes the critical role of transport infrastructure in enhancing the tourist image and attractiveness of the Kabardino-Balkarian Republic, suggesting that improvements in

transport can significantly boost domestic tourism. Alasgarova, (2017) paper emphasizes the critical role of transportation in tourism, highlighting that improved transport infrastructure and logistics are essential for sustainable tourism development, although it does not provide specific path coefficients or statistical analyses as mentioned in your question.

In this current paper, the findings collectively indicate that both TINF and LOPT are not only independently vital for sustainable tourism but also work synergistically—effective logistics operations amplify the benefits of improved transportation infrastructure. The robustness of these results is further supported by rigorous statistical validation. Construct reliability values (CR > 0.87), Cronbach's Alpha (> 0.84), and Average Variance Extracted (AVE > 0.61) all exceed acceptable thresholds, confirming that the measurement models are both reliable and valid. Additionally, discriminant validity is achieved as each construct is distinct from the others, based on the Fornell-Larcker criterion. Overall, this evidence highlights the need for integrated policy planning that simultaneously addresses infrastructure development and logistics system efficiency to foster sustainable tourism. Strategic investments and collaborations in both domains can significantly enhance tourism experiences while promoting environmental, social, and economic sustainability.

In the other stream of literature supporting these narrations, Zhang, (2022) illustrating that transportation infrastructure significantly influences sustainable tourism development by optimizing logistics, reducing carbon dioxide emissions, and enhancing resource distribution. The paper emphasizes the need for effective carbon emission accounting methods to support green development in China's tourism and transportation sectors. Tachaphan et al., (2024) stated that transportation infrastructure is crucial for sustainable tourism development, as efficient logistics management enhances tourist satisfaction. Ezenwa et al., (2025) propounded that eco-friendly infrastructure, such as Cape Town's electric buses, as a sustainable logistics strategy. It emphasizes the need for resilient transportation systems and stakeholder collaboration to optimize logistics and support sustainable tourism development in African destinations. Theppitak, (2018) illustrated that effective transportation infrastructure is crucial for sustainable tourism development, particularly in Koh Lan, Thailand. Optimizing logistics management enhances tourist movement from Pattaya, supports infrastructure planning, and addresses environmental concerns, ensuring a balance between tourism growth and ecological preservation.

Furthermore, CHEN, (2024), the paper focuses on transportation route optimization in green logistics, emphasizing data-driven approaches to reduce energy consumption and carbon emissions, which indirectly supports sustainable tourism development by enhancing logistics efficiency and minimizing environmental impact. Батманов et al., (2023) emphasizes that transport and logistics infrastructure is crucial for sustainable development, enhancing economic indicators and quality of life while ensuring environmental safety. It highlights the need for optimized logistics to support sustainable tourism and regional competitiveness. Mishra et al., (2024) emphasizes that optimized logistics and supply chain practices enhance transportation infrastructure, contributing to sustainable tourism development. Strategic coordination among transportation providers and local suppliers improves service quality, reduces costs, and fosters economic benefits for communities, enhancing overall tourist experiences. Li et al., (2021) focuses

on optimizing logistics infrastructure investment and CO2 emission taxes for sustainable city logistics, emphasizing the balance between economic and environmental goals, which can indirectly support sustainable tourism development through improved transportation infrastructure and reduced emissions. Soliyev & Махмудов, (2024) focuses on infrastructure development's impact on Uzbekistan's logistics sector, emphasizing transportation networks' role in enhancing efficiency and supporting sustainable practices, which indirectly benefits sustainable tourism development through improved logistics optimization and reduced costs.

5. Conclusion and recommendations

5. 1 Conclusion

In conclusion, while transportation infrastructure is a foundational enabler of tourism, its full potential is only realized when logistics systems are strategically optimized. As Tanzania and other developing countries seek to grow their tourism sectors sustainably, an integrated approach that combines infrastructure development with logistics coordination is essential. This study contributes to the literature by highlighting the moderating role of logistics optimization and provides policy-relevant insights to improve tourism planning, investment, and service delivery. This study provides compelling evidence that transportation infrastructure (TINF) and logistics optimization (LOPT) are critical, interrelated drivers of sustainable tourism development (STD). Through robust structural equation modeling and validity assessments, the analysis confirms that both TINF and LOPT independently enhance STD. More importantly, the interaction between the two constructs demonstrates a statistically significant moderation effect, indicating that the positive impact of transportation infrastructure on sustainable tourism is significantly amplified when logistics systems are optimized. These results highlight that while investments in physical infrastructure are necessary, they are not sufficient on their own. Logistics optimization adds strategic and operational efficiency that ensures accessibility, reduces environmental impact, and enhances visitor satisfaction. The findings advocate for a systemic view of tourism development—one that encompasses not just physical assets but also the managerial, technological, and operational practices that underpin their effective use. By explaining 58% of the variance in sustainable tourism development, the model presents a strong case for integrated development frameworks in tourism planning. This comprehensive understanding bridges a critical gap in both theory and practice, particularly in developing contexts where infrastructure development is often prioritized without corresponding improvements in logistical support. For stakeholders in the tourism, transport, and logistics sectors, the findings emphasize the importance of collaboration, joint planning, and strategic investments. In addition, the study opens new pathways for future research on how logistics capabilities mediate or moderate the effects of infrastructure on broader developmental outcomes. In sum, sustainable tourism development requires not just building better roads, airports, and facilities, but also ensuring that these systems function efficiently, coherently, and in alignment with sustainable practices through logistics optimization. This dual focus provides a more holistic and effective route toward resilient and competitive tourism sectors, especially in emerging economies seeking to maximize tourism's contribution to economic growth and sustainability goals.

In regions where transportation infrastructure has already contributed significantly to tourism growth, stakeholders (government bodies, tourism firms, planners) might grow complacent, assuming that further improvement is unnecessary because the current system is "working." This complacency can lead to hubris—an overconfidence in the existing infrastructure's ability to sustain tourism development without continued innovation, investment, or environmental consideration. However, sustainable tourism requires adaptive and optimized logistics—that is, continuously improving how tourists and resources move efficiently and sustainably.

As this study focus on the moderating effect of logistics optimization, it highlights that success alone (from transportation infrastructure) is not enough. Without actively optimizing logistics, success may plateau or even decline due to inefficiencies, environmental strain, or mismanagement—consequences of complacency and hubris. The phrase warns that relying too heavily on existing transportation success without further optimizing logistics can result in stagnation or decline in sustainable tourism. Your research tackles this by examining how logistics optimization can prevent complacency and sustain tourism development.

5.2 Recommendations:

Governments and development agencies should adopt an integrated approach that simultaneously improves transportation infrastructure and optimizes logistics systems to foster sustainable tourism development. Policy formulation must involve multi-sector collaboration across tourism, transport, and logistics to ensure cohesive planning. Resources should be allocated not only to physical development but also to systems that improve logistical coordination, environmental performance, and visitor experience. Capacity building through training and awareness campaigns is essential to institutionalize these practices. Ultimately, national tourism strategies should embrace a systems-thinking perspective that recognizes the interdependence between infrastructure and logistics in achieving sustainable tourism outcomes.

5.2.1 Managerial Recommendations

Tourism managers should actively integrate logistics optimization practices into their operational strategies to complement existing infrastructure. This includes implementing technologies for real-time tracking, route optimization, and customer service enhancement. Collaboration with transport providers should be prioritized to ensure seamless tourist experiences from arrival to destination. Managers must invest in training staff on logistics coordination, environmental practices, and cross-sector collaboration. Additionally, performance metrics should include logistics efficiency indicators, ensuring that infrastructure investments translate into tangible service improvements. By embedding logistics capabilities into tourism operations, managers can enhance competitiveness, visitor satisfaction, and sustainability across the tourism value chain.

5.2.2 Practical Recommendations

Practitioners in tourism and transportation should prioritize integrated planning and execution to ensure that infrastructure investments yield optimal outcomes. This involves leveraging digital

logistics tools for better coordination, adopting eco-friendly transport solutions, and synchronizing service delivery across the tourism supply chain. Destination managers should collaborate with logistics experts to design visitor flows that reduce congestion and environmental degradation. Public-private partnerships can be used to improve infrastructure maintenance while ensuring operational efficiency. Ultimately, focusing on both physical and logistical components will enhance the overall tourist experience, reduce costs, and promote the long-term sustainability of tourism destinations

5.2.3 Theoretical Implications

Theoretically, this study advances knowledge by illustrating how logistics optimization moderates the relationship between transportation infrastructure and sustainable tourism development. It extends existing models of tourism development by integrating operations management concepts, particularly the interaction between physical and process-based capabilities. The significant moderation effect underscores the importance of combined infrastructural and logistical perspectives in sustainability research. This study also reinforces the utility of resource-based and systems theories in understanding tourism competitiveness. Future research should explore other moderating or mediating variables, such as digital infrastructure or environmental policies, to deepen understanding of mechanisms driving sustainable tourism outcomes.

5.2.4 Policy Implications

The findings of this study underscore the critical need for policymakers to adopt a more integrated and strategic approach in planning for sustainable tourism development. While investment in transport infrastructure (TINF) has a proven positive impact on sustainable tourism development (STD), the study reveals that its effectiveness is significantly enhanced when combined with Logistics Optimization (LOPT). This indicates that focusing solely on physical infrastructure without addressing the operational efficiency of logistics systems may result in underutilized investments and diminished returns in the tourism sector. Policymakers should therefore design national and regional tourism development plans that not only prioritize the expansion and maintenance of roads, airports, and transport hubs but also integrate logistics management capabilities such as digital tracking systems, route optimization, and capacity planning. Collaboration between transport, logistics, and tourism ministries should be institutionalized through inter-ministerial committees or task forces that work toward harmonizing policy actions, resource allocations, and performance indicators. Furthermore, public-private partnerships (PPPs) should be encouraged to leverage private sector expertise in logistics innovation while using public investment to improve foundational infrastructure. The inclusion of logistics standards and performance-based benchmarks in tourism infrastructure projects can ensure that logistical efficiency is built into project design and implementation. Regional governments and municipal councils should also be empowered to localize these integrated strategies based on the unique needs and challenges of tourism hotspots. Lastly, policies should aim to build capacity by training professionals in tourism and logistics management to ensure the sustainability of these

interventions. In sum, for tourism to contribute effectively to sustainable development, policies must evolve beyond siloed investments in infrastructure toward a holistic framework that includes logistics optimization as a strategic enabler of accessibility, service quality, and environmental sustainability in the tourism value chain.

5.2.5 Practical Implications

The practical implications of this study highlight the need for actionable collaboration and operational alignment between tourism operators, transportation providers, and logistics managers to fully realize the benefits of transport infrastructure in promoting sustainable tourism development. From a managerial standpoint, tourism businesses and tour operators should not only rely on improved physical infrastructure but must also integrate logistics optimization into their service models. This includes using technologies such as real-time tracking, automated scheduling, and demand forecasting tools to enhance the reliability and responsiveness of transportation services. Transport companies that serve tourism areas should streamline their fleet management, reduce travel times, and optimize routes to minimize fuel consumption and environmental impact, all of which contribute to the sustainability agenda. Additionally, tourism planners and site managers in destinations like Ngorongoro should ensure that transportation facilities are designed with logistical flow and visitor movement in mind, to avoid congestion and delays that degrade tourist experiences. Training drivers and logistical staff on customer care, sustainability practices, and coordination with tourism agencies can also lead to improved service quality. Furthermore, tourism agencies should partner with logistics providers to co-develop packages that guarantee not just transportation but seamless mobility, from airport pickups to remote site visits, in a coordinated and environmentally conscious manner. Industry associations can facilitate knowledge sharing and standard setting for logistics practices that support tourism sustainability. On a broader level, integrating logistics strategies into destination management plans can help local communities benefit more from tourism through efficient supply chain linkages. Overall, the study's findings call for a shift in practical approaches—from treating transport infrastructure and logistics as separate entities, to viewing them as interdependent systems that together create a foundation for a thriving and sustainable tourism industry. Embracing this integrated approach will enhance tourist satisfaction, operational efficiency, and long-term destination competitiveness.

REFERENCES

Alasgarova, F. (2017). *U*nderstanding of tourism transportation and its azerbaijan model. *Environmental Science, Geography, Business, Economics,2*(1), 45–49. https://doi.org/10.24045/PP.2017.1.8

Andru, S. (2024). Optimizing Company Performance Through Effective Logistics Management. *Deleted Journal*, *20*(10s), 6039–6044. https://doi.org/10.52783/jes.6545

Bai, Y., Kou, X., An, S., Ouyang, Y., Wang, J., & Zhu, X. (2014). Integrated Planning of Tourism Investment and Transportation Network Design. *Transportation Research Record*, *2467*(2467), 91–100. https://doi.org/10.3141/2467-10

Bakari, S. J., et al. (2024). Tanzania's Treasure: Community Empowerment through Sustainable Cultural Heritage Tourism. Technium Social Sciences Journal. 60:330-347. doi:10.47577/tssj.v60i1.11403

Bengesi, K., Mwesiga, P., & Mrema, T. (2016). Public private partnership in Tanzania's transportation infrastructure: the way PPP is understood, challenges and the way forward.

Bentalha, B. (2023). *Sustainable Supply Chain Management in Tourism* (pp. 53–66). Routledge. https://doi.org/10.4018/979-8-3693-2065-5.ch004

Byrne, B. M. (2016). *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. Routledge.

Calderón, C., Cantu, C., & Chuhan-Pole, P. (2018). Infrastructure Development in Sub-Saharan Africa: A Scorecard. Political Economy - Development: Public Service Delivery eJournal.

CHEN, Q. (2024). Data-Driven and Sustainable Transportation Route Optimization in Green Logistics Supply Chain. *Deleted Journal*, *1*(6), 140–146. https://doi.org/10.62177/apemr.v1i6.118

Chen, T. (2014). The coordination in spatial-temporal variations of regional tourism development: A tourism system prospective. *Geographical Research*. https://en.cnki.com.cn/Article_en/CJFDTOTAL-DLYJ201403015.htm

Dinu, A.-M. (2018). The Importance of Transportation to Tourism Development. *Academic Journal of Economic Studies*, *4*(4), 183–187.

Ersoy, B.M. (2019). A Case Study Based Mix-Method Research Design for Practicing Resource Orchestration in Tourism Destinations.

Ezenwa, A., Ede, O., & Oledinma, A. (2025). Sustainable Logistics Solutions for Managing Overtourism in African Destinations. *Advances in Hospitality, Tourism and the Services Industry (AHTSI) Book Series*, 343–378. https://doi.org/10.4018/979-8-3693-8347-6.ch017

Figini, P. (2022). *The coordination challenge in tourism destinations: value creation, enhancement, and retention*. https://doi.org/10.4337/9781800378766.00014

Florido-Benítez, L. (2024). Increasing Security Levels in the Tourism and Air-Transport Industries Could Enhance African People's Quality of Life and Tourism Demand. Tourism and Hospitality.

George, D., & Mallery, P. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference*. Allyn & Bacon.

Gruchmann, T., Eiten, J., De La Torre, G., & Melkonyan, A. (2019). *Sustainable Logistics and Transportation Systems: Integrating Optimization and Simulation Analysis to Enhance Strategic Supply Chain Decision-Making* (pp. 265–279). Springer, Cham. https://doi.org/10.1007/978-3-319-98467-4_12

Haulle, E. (2019). Accumulation Tendency, Sustainable Tourism and Hospitality in Tanzania. *International and Multidisciplinary Journal of Social Sciences*.

Hetisani, H. M. (2014). The effects of transport infrastructure towards planning for tourism in South Africa: the case of corridor developments. Conference Paper.

Hlotywa, A., & Ndaguba, E. (2017). Assessing the impact of road transport infrastructure investment on economic development in South Africa. Journal of Transport and Supply Chain Management, 11.

Hu, J. (2024). *Research on logistics supply chain optimization strategy based on machine learning*. https://doi.org/10.1117/12.3024778

Ivanková, V., Gavurová, B., Bačík, R., & Rigelský, M. (2021). Relationships between road transport infrastructure and tourism spending: A development approach in European OECD co

Junton, P., & Kamthornphiphatthanakul, S. (2023). Tourism logistics management influening logistics performance, satisfaction, and loyalty of tourisms in songkhla province. *International Journal of Management Studies and Social Science Research*, *05*(06), 174–183. https://doi.org/10.56293/ijmsssr.2023.4718

Kang, Z. (2023). The Impact of Transport Infrastructure Development in Africa on the Development of Regional Integration in Africa. Highlights in Business, Economics and Management.

Kanwal, S., Rasheed, M. I., Pitafi, A. H., Pitafi, A., & Ren, M. (2020). Road and transport infrastructure development and community support for tourism: The role of perceived benefits, and community satisfaction. Tourism Management, 77, 104014.

Kauzen, R., Sun, B., & Frank, H. (2020). Does Transport Infrastructure Have an Impact on Economic Growth?: Observed Fact from Tanzania. International Conference on Management Engineering, Software Engineering and Service Sciences.

Khaksar, M. R., & Amir, E. (2023). The contribution of tourism to the economic growth of a country. *International Journal of Current Science Research and Review, 6*(7), 4917–4921. https://doi.org/10.47191/ijcsrr/V6-i7-107

Kisinga, D., Mchopa, A., & Mwagike, L. (2024). Supplier relationship management and business performance of small-scale grapes processing firms in Dodoma, Tanzania: the moderating role of logistics capabilities. IIMT Journal of Management.

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling*. Guilford Press.

Kusumastuti, H., et al. (2024). Leveraging Local Value in a Post-Smart Tourism Village to Encourage Sustainable Tourism. *Sustainability*.

Li, S., Liang, Y., Wang, Z., & Zhang, D. (2021). An Optimization Model of a Sustainable City Logistics Network Design Based on Goal Programming. *Sustainability*, *13*(13), 7418. https://doi.org/10.3390/SU13137418

Lin, C. (2022). *Tourism and Transport* (p. C6.P1-C6.N84). Oxford University Press eBooks. https://doi.org/10.1093/oxfordhb/9780190889555.013.6

Liu, B., & Huang, A. (2025). Digital economy and tourism growth: the role of online attention allocation and transportation infrastructure. Tourism Review.

Liu, K., Wang, Q., Wang, M., & Koks, E. (2022). Global transportation infrastructure exposure to the change of precipitation in a warmer world. Nature Communications.

Lopresti, I., & Tartaglia, M. (2024). *The Relationship Between High-Speed Rail Accessibility and Tourism Demand: The Case Study of Italy* (pp. 473–491). Springer International Publishing. https://doi.org/10.1007/978-3-031-53684-7_22

Lwoga, N. (2019). Moderating effect of heritage spatial proximity on the relationship between perceptual proximity and residents' attitudes towards tourism. African Geographical Review, 38, 268–282. https://www

Ma, L. N. (2022). Application of Fuzzy Particle Swarm Optimization Algorithm in Optimizing Logistics Distribution Management System. *2022 IEEE 2nd International Conference on Electronic Technology, Communication and Information (ICETCI)*, 1189–1192. https://doi.org/10.1109/icetci55101.2022.9832072

Macha, L. (2021). Tanzania Citizens' Participation in Domestic Tourism. International Journal for Innovation Education and Research, 9, 209–236.

Marques, B. (2016). Transport-tourism: capacity coordination. *Research Papers in Economics*. https://hal.univ-antilles.fr/hal-01265818

Massawe, D., Mbura, O., Elly, T., & Masanja, C. (2024). Continuous Social Media Use Intention in the Accommodation Sector Recovery during Post-Covid-19 Pandemic: Reflection on the Tanzania Experience. ORSEA JOURNAL.

Merkulov, M., Zakharchenko, V., & Metil, T. (2022). Logistic support for the sustainable functioning of enterprises in the tourism sector. *Naukovij Vìsnik Mìžnarodnogo Gumanìtarnogo Unìversitetu*, *52*. https://doi.org/10.32841/2413-2675/2022-52-8

Messori, S., & Volo, S. (2024). Tourism firms' coordination unravelled. *Current Issues in Tourism*. https://doi.org/10.1080/13683500.2024.2328691

Mgonja, J. T. (2020). Development of tourism in Tanzania: Strengthening agriculture–tourism linkages. In G. Novelli (Ed.), *Routledge handbook of tourism in Africa* (1st ed., pp. 18–34). Routledge. https://doi.org/10.4324/9781351022545

Miller, G., & Torres-Delgado, A. (2023). Measuring sustainable tourism: a state of the art review of sustainable tourism indicators. *Journal of Sustainable Tourism, 31*, 1483-1496.

Milwood, P.A., & Roehl, W.S. (2018). Orchestration of innovation networks in collaborative settings. *International Journal of Contemporary Hospitality Management*.

Mishra, K. K., Singh, C., Mishra, S., & Soni, K. (2024). Enhancing tourism experiences through efficient logistics and supply chain practices. *ShodhKosh Journal of Visual and Performing Arts*, *5*(5). https://doi.org/10.29121/shodhkosh.v5.i5.2024.3616

Mlozi, S., & Pesämaa, O. (2018). Antecedents of national park knowledge in Tanzania. Journal of Ecotourism, 18, 199–220.

Mollel, D. (2024). Promoting the Progression of Expeditions and Implementing Policies to Enhance Sustainable Tourism Development in Tanzania. *Journal of Financial Risk Management*.

Mtapuri, O., et al. (2023). Sustainable Tourism Development: Insights From South Africa and the Continent. *SSRN Electronic Journal*.

Muresherwa, G., Makuzva, W., & Dube, C. N. (2024). Sustainable Tourism Practices in the Post-Covid Era: Lessons from Southern Africa. *International Conference on Tourism Research*.

Murniati, M. (2024). Impact of Transportation Infrastructure on Tourism Development: Analyzing Factors Influencing Visit Decisions and Economic Welfare Improvement. *Pakistan Journal of Life and Social Sciences*, *22*(2). https://doi.org/10.57239/pjlss-2024-22.2.00818

Mwemezi, J. J., & Huang, Y. (2012). Inland container depot integration into logistics networks based on network flow model: The Tanzanian perspective. African Journal of Business Management, 6, 7149-7157.

Mwipopo, A., & Massawe, P. (2024). Influence of Tourism on Socio-economic Livelihood among Households Living near Conservation Areas in Tanzania. NG Journal of Social Development.

Nag, A., & Sarkar, S. (2024). Integrating choice freedom, economic health, and transportation infrastructure to forecast tourism demand: A case study of Bishnupur and its alignment with sustainable development goals. *Transport Policy*. https://doi.org/10.1016/j.tranpol.2024.01.001

Niewiadomski, P., & Brouder, P. (2024). From 'sustainable tourism' to 'sustainability transitions in tourism'?. *Tourism Geographies, 26*, 141-150.

Njoya, E. T. (2022). Assessing the poverty impact of the COVID-19-induced tourism crisis in Tanzania: a social accounting matrix microsimulation analysis. Journal of Sustainable Tourism, 31, 801–820.

Nunkoo, R., & Seetanah, B. (2018). Foreign direct investment and tourism development: a theoretical and empirical review. In C. Cooper, S. Volo, W. C. Gartner, N. Scott (Eds.) *Foreign Direct Investment and Tourism Development: A Theoretical and Empirical Review* (pp. 556-566). SAGE Publications Ltd, https://doi.org/10.4135/9781526461452.n33

Nyasha, S., & Odhiambo, N. (2024). Does transport infrastructure spur economic growth in south Africa? an empirical investigation. Facta Universitatis, Series: Economics and Organization.

Pachaury, A. (2024). Sustainable Tourism Infrastructure Development. *Indian Scientific Journal Of Research In Engineering And Management*. https://doi.org/10.55041/ijsrem32769

Peeters, P., Çakmak, E., & Guiver, J. (2024). Current issues in tourism: Mitigating climate change in sustainable tourism research. *Tourism Management*.

Peuscher, D.W. (2016). The Resource Orchestration Theory as contributor to Supply Chain Management: an assessment on its applicability.

Radushinskaya, A., & Chernomorets, A. B. (2023). Analysis of the impact of transport infrastructure on the attractiveness of the tourist destination of the kabardino-balkarian republic. *Èkonomika Severo-Zapada: Problemy i Perspektivy*. https://doi.org/10.52897/2411-4588-2023-3-105-11

Robinson, G. (2021). Case study: developing Tanzania's transport infrastructure management system (TIMS). Conference Proceedings.

Siriwardena, S., Edirisinghe, L., & Silva, D. A. C. S. (2023). Interdependence of Logistics and Tourism: Crafting a Novel Logistics Concept in Tourism. *Sustainable Development Research*, *5*(1), p87. https://doi.org/10.30560/sdr.v5n1p87

Soliyev, A. E., & Махмудов, С. (2024). Infrastructure development and its impact on sdg 9 in uzbekistan's logistics sector. *Deleted Journal*, *1*(6), 62–67. https://doi.org/10.61796/ijeirc.v1i6.140

Subkhan, M. F., Taali, M., Puspitasari, D. A. K., & Amri, L. H. A. (2024). *Logistic transportation role for sustainable ecotourism industry*. https://doi.org/10.1088/1742-6596/2828/1/012014

Sun, B., & Kauzen, R. (2023). The Impact of Port Infrastructure and Economic Growth in Tanzania: Adopting a Structural Equation Modeling Approach. SAGE Open.

Tachaphan, T., Inladom, R., & Pongsida, S. (2024). *Sustainable Tourism Logistics Management Strategies: A Case Study of Pathum Thani Province, Thailand*. https://doi.org/10.20944/preprints202410.0882.v1

- Tan, P. Y., & Ismail, H. N. (2020). Reviews on interrelationship between transportation and tourism: Perspective on sustainability of urban tourism development. *IOP Conference Series Earth and Environmental Science , 447*(1), 012065. https://doi.org/10.1088/1755-1315/447/1/012065

Theppitak, T. (2018). *Managing Tourism Logistics with Sustainable Development of Eco-Tourism*. *5*(8), 1. https://doi.org/10.26836/IJASRD/2018/V5/I8/50801

Vucetic, S. (2011). Logistics Management as a Function of Sustainable Development of Tourist Destination. *Business Logistics in Modern Management*, *11*, 319–328. https://ideas.repec.org/a/osi/bulimm/v11y2011p319-328.html

Vucetic, S. (2011). Logistics Management as a Function of Sustainable Development of Tourist Destination. *Business Logistics in Modern Management*, *11*, 319–328.

Wang, Y., Wang, M., Li, K., & Zhao, J. (2021). Analysis of the Relationships between Tourism Efficiency and Transport Accessibility—A Case Study in Hubei Province, China. *Sustainability*, *13*(15), 8649. https://doi.org/10.3390/SU13158649

Wilkinson, P.F. (2018). Transforming travel: realising the potential of sustainable tourism. *Anatolia, 29*, 292 - 294.

Wu, C., Zhang, N., & Xu, L. (2021). Travelers on the Railway: An Economic Growth Model of the Effects of Railway Transportation Infrastructure on Consumption and Sustainable Economic Growth. *Sustainability*, *13*(12), 6863. https://doi.org/10.3390/SU13126863

Zhang, Q. (2022). Investigating the Impact of Transportation Infrastructure and Tourism on Carbon Dioxide Emissions in China. *Journal of Environmental and Public Health*, *2022*, 1–9. https://doi.org/10.1155/2022/8421756

Батманов, Э. З., Алимагомедова, Н. Э., Батманова, К. М., & Расулов, Р. М. (2023). Transport and logistics infrastructure as a factor of sustainable development of the region. *ЭкономикаиПредпринимательство*.https://doi.org/10.34925/eip.2023.153.4.096

ЖУКОВСКАЯ, И. Ф., & ОВЧИННИКОВ, А. Ю. (2024). Logistics and tourism: interconnection andinterdependence. *ЭкономикаиПредпринимательство*.https://doi.org/10.34925/eip.2024.163.2.201