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Crisis to resilience: tracing direct, indirect and induced tourism impacts in Kenya's economy

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Abstract

Tourism shocks can propagate well beyond visitor-facing industries through production networks, factor incomes, and household consumption. This study estimates the economy-wide effects of the COVID-19 tourism shock in Kenya using the Kenya Tourism Satellite Account (TSA) 2019 and publicly available Kenya Social Accounting Matrices (SAMs). Separate product-level final-demand shocks are constructed for inbound and domestic tourism in 2020 and 2021 relative to the 2019 benchmark. The combined visitor-demand contraction is estimated at KSh338.8 billion in 2020 and KSh174.2 billion in 2021. Using the 2019 Kenya SAM, these shocks generate estimated economy-wide gross-output contractions of KSh770.8 billion and KSh408.8 billion, respectively, alongside factor-value-added effects of KSh396.1 billion and KSh206.8 billion. Direct tourism employment-equivalent contractions are estimated at approximately 508,000 positions in 2020 and 249,000 in 2021. Inbound tourism accounts for most of the persistent 2021 shortfall, while domestic tourism recovers substantially faster. Transportation, accommodation, and food services experience the largest effects, with sizeable spillovers into trade, processed foods, agriculture, and business services. Structural sensitivity analysis using the 2021 Kenya SAM yields approximately 10% lower gross-output effects while preserving the direction and principal sectoral ranking of the findings. The results demonstrate both Kenya's vulnerability to external tourism-demand shocks and the value of domestic tourism resilience, supporting policies that strengthen domestic and regional markets, supply-chain resilience, economic diversification, and inclusive crisis-response mechanisms.

Introduction

Kenya's tourism sector is a cornerstone of the national economy, contributing significantly to GDP, employment, and foreign exchange earnings. Historically, the sector has demonstrated both dynamism and vulnerability, with its fortunes closely tied to global and local shocks, including political instability, health crises, climate variability, and economic downturns (Pepela and Mutanda, 2024; Kimunio and Maingi, 2023; Chiawo et al., 2023; Siringi, 2021). The COVID-19 pandemic starkly exposed these vulnerabilities, precipitating unprecedented declines in international arrivals, hotel occupancy, and sectoral revenues, while triggering cascading effects across related industries such as transport, retail, and agriculture (Pepela and Mutanda, 2024).

However, the pandemic is only the latest in a series of disruptions that have tested the adaptive capacity of Kenya's tourism sector. Prior crises, ranging from disease outbreaks to security incidents and ecological shocks, have similarly emphasised the need for robust crisis management, sectoral resilience, and economic diversification. The imperative

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to reduce over-reliance on tourism and build resilience against future shocks is central to policy and scholarly debates, both within Kenya and globally (Misorimaligayo, 2024; Gowreesunkar et al., 2024).

This study situates Kenya's tourism sector within the broader literature on crisis management, tourism resilience, and shock response. It synthesises empirical evidence and theoretical frameworks to bridge the gap between immediate crisis response and long-term adaptive strategies, offering insights relevant to sustainable tourism development, public policy, and economic transformation. Crisis management in tourism encompasses strategies from risk assessment and emergency planning to recovery and resilience-building. The literature increasingly advocates systemic, multi-theoretical approaches integrating social impacts, community resilience, and socio-ecological perspectives to grapple with interdependent economic, social, and environmental factors (Misorimaligayo, 2024; Drammeh, 2024). Tourism resilience is conceptualised as a dynamic process of transformation, innovation, and learning. Frameworks such as the Everyday Health System Resilience model, formulated from Kenyan and South African experiences, emphasise absorptive, adaptive, and transformative capacities, supported by leadership, community networks, and intersectoral collaboration (Gilson and Barasa, 2024). These perspectives inform locally led, context-sensitive, and inclusive tourism planning.

The global COVID-19 pandemic profoundly affected tourism as governments implemented travel restrictions, border closures, and lockdowns to contain the virus (Rodousakis and Soklis, 2022). These measures had particularly severe consequences in tourism-dependent economies. In Kenya, the Tourism Satellite Account estimated Tourism Direct Gross Domestic Product (TDGDP) at approximately KSh432 billion in 2019, equivalent to almost 4.4% of national GDP, while direct tourism employment was estimated at 989,320 positions (Tourism Research Institute, 2022b). The scale of these direct contributions, combined with tourism's extensive linkages to transport, food services, trade, agriculture, and other activities, increased the potential for a tourism-demand shock to propagate through the wider economy. Official national accounts further illustrate the severity of the shock in visitor-facing activities. At current prices, value added in accommodation and food service activities declined from KSh119.6 billion in 2019 to KSh77.8 billion in 2020, before recovering to KSh190.8 billion in 2023 (Kenya National Bureau of Statistics, 2024). Modern-sector wage payments in the industry similarly increased from approximately KSh25.6 billion in 2020 to KSh51.7 billion in 2023, indicating a substantial recovery in economic activity and labour earnings after the initial pandemic disruption (Kenya National Bureau of Statistics, 2024).

Kenya's tourism sector has long been recognised as vulnerable to external shocks. A seminal study by Summary (1987) was among the first to systematically assess tourism's multiplier effects on Kenya's economy, demonstrating extensive linkages across employment, income generation, and household welfare. Subsequent international research has emphasised the importance of multiplier effects in tourism analysis. For instance, studies in Latin America reveal that tourism generates complex intersectoral flows through intermediaries like travel agents and tour operators (Garrido and Moreno-Izquierdo, 2025). Input–output analyses in Germany's protected areas indicate substantial indirect value-added multipliers, with ratios nearing 30% (Majewski, 2024). Research in Southern Africa illustrates that tourism employees' spending patterns stimulate local economic development more effectively than those of other community groups (Snyman and Spenceley, 2019). Collectively, these studies underscore the value of multiplier approaches in capturing tourism's direct and indirect economic benefits across diverse contexts.

Global evidence highlights how crises disrupt these multiplier channels. Spain's Balearic Islands experienced an 87% collapse in arrivals (Moreno-Luna et al., 2021), Ghana's ecotourism sector faced severe livelihood losses (Soliku et al., 2021), and Thailand relied on agricultural tourism for recovery (Sangnak et al., 2025). Within Africa, South Africa's wildlife tourism sector (van der Merwe et al., 2021), Zambia's South Luangwa National Park (Chidakel et al., 2021), and Tanzania's tourism sector (Henseler et al., 2022) all experienced substantial pandemic-related disruption. Similar pandemic-related disruption was documented in Japan (Kitamura et al., 2020). These comparative insights position Kenya's experience within a broader global pattern, where tourism-dependent economies, particularly in the Global South, face disproportionate risks when international travel collapses.

The vulnerabilities faced by Kenya are consistent with findings from other tourism-dependent economies, particularly within emerging markets. For instance, van der Merwe et al. (2021) documented how South Africa's private wildlife tourism sector suffered severe financial losses, with cascading impacts on employment and conservation financing. Similarly, Chidakel et al. (2021) found that the collapse of international tourism in Zambia's South

Luangwa National Park generated substantial multiplier effects and revenue leakages, undermining local livelihoods. In Kenya, Tahanout and Berkane (2021) documented substantial pandemic-related disruption to the tourism sector and highlighted the need for recovery strategies that reduce vulnerability to external shocks.

These studies collectively highlight how over-reliance on tourism accentuates structural vulnerabilities in emerging economies, where limited diversification constrains resilience to global shocks. Beyond Africa, Kitamura et al. (2020) documented the economic, environmental, and social effects of the pandemic on Japan's tourism industry, while Liu et al. (2023) highlighted tourism's broader contribution to rural community development. These comparative insights reinforce that Kenya's experience is part of a broader global pattern in which tourism-dependent economies, particularly in the Global South, face disproportionate risks when international travel demand collapses.

Shock response mechanisms in tourism draw lessons from multiple sectors, promoting integrated policy interventions, digital innovation, and community-driven models. The confluence of crisis management, resilience theory, and economic diversification offers fertile ground for reimagining Kenya's tourism sector as a growth driver and a locus of sustainable, adaptive development. Taken together, these findings suggest that Kenya's COVID-19 tourism shock should be understood within a broader international and historical framework. While tourism's multiplier effects generate powerful growth linkages, they also amplify vulnerability during global crises that interrupt visitor flows. By revisiting early Kenyan studies (Summary, 1987) alongside recent global analyses, this study situates Kenya's experience within the wider discourse on tourism's dual role as both a growth engine and a channel of fragility.

The primary research problem addressed in this paper is the lack of a transparent and reproducible Kenya-specific assessment of how the COVID-19 tourism-demand shock propagated beyond visitor-facing industries through interindustry, factor-income, and household-consumption linkages. While it is well known that the pandemic devastated tourism globally, few studies provide a comprehensive assessment of how these effects cascaded through the Kenyan economy. The multiplier effects of reduced tourism spending on sectors such as agriculture, retail, and transportation remain underexplored in existing literature (Nechifor et al., 2021; Tchouamou Njoya, 2022).

The significance of this research lies in providing a transparent and reproducible assessment of how the COVID-19 tourism-demand shock propagated through the Kenyan economy. The study links the Kenya TSA 2019 benchmark to the publicly available Kenya Nexus Social Accounting Matrix and constructs product-specific tourism-demand shocks using official tourism and national statistical indicators. Separate scenarios are estimated for inbound and domestic tourism in 2020 and 2021, allowing the severity and recovery of the two tourism markets to be compared explicitly. The SAM framework captures interindustry linkages, factor-income effects, and household-consumption feedback, thereby providing a broader assessment of economic vulnerability than direct tourism indicators alone.

Moreover, many of these studies overlook the multiplier effects of reduced tourism on the broader economy, particularly in countries like Kenya, where tourism plays a significant role. This study aims to fill these gaps by providing a comprehensive analysis of how the decline in tourism affects other industries through indirect and induced effects, thereby contributing to a more nuanced understanding of the pandemic's economic impact in Kenya.

Unlike studies that primarily document changes in arrivals, receipts, or tourism-industry performance, this study examines how contractions in tourism demand propagate across the wider Kenyan economy. Its contribution lies in four features: the construction of transparent product-level final-demand shocks; the separation of inbound and domestic tourism effects for 2020 and 2021; the estimation of direct, indirect, and induced monetary effects through a Kenya-specific SAM; and formal sensitivity testing using an alternative SAM structure. This design provides both a clearer assessment of the economic shock and evidence on the role of domestic tourism as a potential resilience mechanism.

Against this background, the study aims to quantify the economy-wide effects of the COVID-19 tourism demand shock in Kenya and assess how these effects differed between inbound and domestic tourism during the initial contraction and subsequent recovery. It also evaluates the sensitivity of the estimated effects to alternative representations of Kenya's economic structure. The study, therefore, addresses the following research questions:

1. What direct, indirect, and induced effects did the constructed tourism-demand shocks generate across Kenya's economy in 2020 and 2021 relative to the 2019 benchmark?

2. How did the magnitude and economy-wide transmission of the shock differ between inbound and domestic tourism?
3. To what extent are the estimated output, factor-value-added, and labour-income effects sensitive to the economic structure represented by alternative Kenya Social Accounting Matrices?

The empirical analysis is interpreted through the lenses of structural vulnerability, tourism dependency, and resilience. These perspectives generate two analytical expectations rather than statistical hypotheses. First, Kenya's exposure to international tourism demand and global mobility is expected to amplify the economic consequences of the inbound tourism shock. Second, domestic tourism is expected to provide a partial resilience mechanism, with domestic demand recovering faster than international visitor flows. The SAM analysis allows these expectations to be assessed by examining the relative magnitude, composition, and sectoral transmission of tourism demand shocks.

The implications of the study are both theoretical and practical. Theoretically, the analysis demonstrates how a TSA-SAM framework can reveal the structural pathways through which a sector-specific tourism-demand shock propagates across production networks, factor incomes, and household consumption. It also contributes to debates on tourism dependency and resilience by distinguishing the recovery dynamics of inbound and domestic demand. Practically, the findings identify economically exposed activities and supply-chain linkages that should be considered in crisis-response, tourism-development, and diversification policies. The use of publicly accessible SAMs and a documented shock-construction process further strengthens the transparency and reproducibility of the analysis.

Theoretical background

Multiplier effects on tourism

Research by Tchouamou Njoya (2022) emphasises the importance of examining multiplier effects, in which reductions in tourism lead to cascading negative impacts across related sectors, including transportation, agriculture, and retail. While these studies highlight the broader consequences of declining tourism demand, they do not offer detailed, Kenya-specific insight. This research contributes to the literature by analysing the indirect and induced effects in a Kenyan context, demonstrating how these sectors are deeply interconnected with tourism. Sun et al. (2022) documented substantial tourism job vulnerability and income inequality effects during the COVID-19 pandemic globally. In Kenya, Nechifor et al. (2021) similarly documented declines in employment and income during the pandemic, illustrating how tourism-related disruption interacted with wider economic pressures.

The multiplier effects of the decline in tourism were equally profound. Bitok (2020) highlights the impact of COVID-19 on tourism, trade, education, and other key economic sectors. The cascading effects in countries like Kenya, where tourism accounts for a significant share of GDP, have affected various industries. Huang et al. (2020) found that policies like business closures reduced employment by 20-30% in sectors directly tied to tourism. Building on these effects, Tchouamou Njoya (2022) examined the relationship between declining tourism and rising poverty. Tourism-income contractions may also exacerbate existing economic disparities. Similarly, Tonnang et al. (2023) highlighted the destabilising effects of pandemic-related restrictions on Kenya's food supply chains, further straining tourism-dependent industries, including culinary and cultural tourism. The economic impacts extended beyond the tourism industry. Nechifor et al. (2021) noted that Kenya's April-June 2020 lockdown resulted in near-zero economic growth, declines in employment and income, and increased government deficit. These effects were particularly pronounced in tourism-dependent sectors, contributing significantly to the country's GDP.

Additionally, Anand and Kim (2021) demonstrated how the collapse of tourism impacted conservation efforts in Kenya's protected areas. With a 75% reduction in tourism-related activities, funding for conservation and related jobs also decreased. This aligns with global findings, including those by Kitamura et al. (2020), which highlight the ripple effects of tourism declines on environmental conservation. Odwori et al. (2022) stressed that the hospitality sector, one of the most impacted in Kenya, experienced significant job losses and operational changes. As pandemic restrictions eased, recovery was observed in some sectors, but it remained dependent on public health stabilisation.

The pandemic's multiplier effects permeated Kenya's economy, leading to income and job losses and hindering conservation efforts. A recovery strategy will necessitate a multifaceted approach, encompassing financial support, public health management, and initiatives to enhance domestic and international tourism (Mwamwanja and Mlozi, 2020). The cumulative effect of the pandemic on Kenya's tourism sector was echoed by Tahanout and Berkane (2021), who documented substantial economic damage.

As Ondicho and Irandu (2021) noted, the decline in international tourism severely affected employment within Kenya's tourism agencies. The effects rippled into other sectors, worsening economic instability. Official Tourism Research Institute data show the scale of the disruption: international arrivals declined from 2,048,834 in 2019 to 567,848 in 2020, before recovering to 870,467 in 2021. Inbound tourism earnings declined from KSh296.201 billion in 2019 to KSh88.562 billion in 2020, then recovered to KSh146.514 billion in 2021 (Tourism Research Institute, 2022a). These changes provide direct evidence of both the severity of the initial external-demand shock and the incomplete recovery of inbound tourism by 2021. It is worth noting Kenya's inbound tourism direct earnings before COVID-19, broken down by product category and visitor type (overnight tourists vs. same-day excursionists). The data highlights accommodation services and air passengers as the top revenue-generating products, underscoring the importance of international tourists to Kenya.

Domestic tourism expenditure

Domestic tourism plays a significant role in Kenya's tourism industry. In 2018, domestic tourists (4.96 million) outnumbered foreign tourists (2.05 million) but fell short of the international threshold, which is typically set at three times the number of international tourists. This suggests Kenya's domestic tourism cannot shield the sector from global market instabilities (Kifworo et al., 2020).

Historically, domestic tourism in Kenya has lagged due to a lack of a supportive environment. Manono and Rotich (2013) noted that tourism investment has mainly targeted affluent international tourists, with domestic tourism only becoming a focus during downturns caused by crises such as terrorism, epidemics, or economic recessions. The importance of domestic tourism became clear during events such as the El Niño floods, the Kikambala bombings, and post-election violence. Research by Odeny (2019) and data from the 2015-2016 Kenya Integrated Household Budget Survey show the underdevelopment of the domestic tourism industry, with average household expenditure of just KSh4,656.72. This highlights the need for targeted policies to enhance the economic contribution of domestic tourism. Studies like Kifworo et al. (2020) emphasise economic constraints and marketing deficiencies, underscoring the growth potential, particularly in Nairobi, through improved infrastructure and financial conditions.

In 2019, domestic visitor expenditure totalled approximately KSh343.3 billion, of which about KSh147.0 billion was associated with road passenger transport services (Tourism Research Institute, 2022b). Many domestic tourists travel to visit friends and relatives, leading to lower reported spending on accommodation and food, as these are often provided informally, with gifts sometimes exchanged as indirect compensation (Lehto et al., 2001).

Tourism, shocks, and resilience mechanisms

Tourism systems are inherently susceptible to a wide range of shocks, including pandemics, natural disasters, economic crises, and political instability. These events cause significant disruptions to tourism activities, impacting both short-term operations and long-term development trajectories. For example, the COVID-19 pandemic led to widespread travel restrictions, economic slowdowns, and socio-psychological barriers to travel, resulting in substantial contractions in global tourism demand (Oğuz, 2023). Similarly, natural disasters such as cyclones, earthquakes, and floods continue to challenge destination stability, often exacerbated by media amplification of risk perceptions (Volgger et al., 2018; Gök and Aylan, 2024). The global financial crisis of 2007–2010 further exposed the interconnected vulnerabilities within the tourism sector (Hall, 2010).

To address these vulnerabilities, tourism destinations develop resilience mechanisms broadly categorised into resistance and recovery strategies. Resistance refers to the capacity to withstand shocks without major disruptions,

while recovery denotes the ability to return to baseline or improved states following disturbances (Jiao et al., 2025). Key strategies that enhance resilience include technological advancements, innovative business models, and strategic partnerships fostering adaptability and transformation (Sharma et al., 2024). The digital economy plays an increasingly critical role by enhancing economic growth, technological infrastructure, and human capital development in tourism-dependent economies (Lu et al., 2024).

Input-Output (I-O) and Social Accounting Matrix (SAM) models are pivotal analytical tools in assessing the economic consequences of shocks on tourism. These frameworks enable estimation of multiplier effects and the ripple impacts that tourism activities exert across regional economies. By embedding I-O and SAM models within broader shock-response and resilience frameworks, researchers can more comprehensively understand the spatial and temporal dimensions of tourism-system resilience and inform effective crisis management strategies (Jiao et al., 2025).

This study also situates its modelling approach within broader conceptual debates on structural economic vulnerability, tourism dependency, and resilience thinking. Structural vulnerability frameworks emphasise that economies heavily reliant on a single sector, such as tourism, face disproportionate risks during global crises because limited diversification constrains their capacity to absorb shocks. Tourism dependency theory further articulates how over-reliance on tourism as a primary economic driver can generate sectoral imbalances and impede sustainable development, particularly in emerging economies (Chaperon and Bramwell, 2013). In contrast, resilience thinking highlights the importance of adaptive capacity and of economies' ability to recover and transform in the face of external shocks such as the COVID-19 pandemic (Folke, 2010).

Methodologically, this study contributes to a growing body of literature that applies I-O and SAM models to assess tourism shocks in Global South contexts. For example, Tchouamou Njoya (2022) employed a SAM microsimulation to examine the poverty impacts of COVID-19 in Tanzania, while Jones (2010) applied SAM analysis in Mozambique to capture tourism's inter-industry linkages. Akkemik (2012) demonstrated the role of SAM in assessing tourism's importance for Turkey's economy, and Nechifor et al. (2021) used I-O modelling to quantify COVID-19 impacts on food security and welfare in Kenya and Sub-Saharan Africa.

Relatedly, van der Merwe et al. (2021) and Chidakel et al. (2021) have shown how these approaches reveal extensive employment and value-added losses in South Africa and Zambia, underscoring similar structural vulnerabilities across the region. By explicitly drawing on these comparative studies and theoretical debates, the Kenyan case presented here is positioned as both context-specific and integrative of wider Global South discourses, underscoring its originality within the literature.

Materials and methods

This study applies a Tourism Satellite Account-Social Accounting Matrix (TSA-SAM) multiplier framework to estimate the economy-wide effects of the COVID-19 tourism-demand shock in Kenya. The Kenya Tourism Satellite Account (TSA) 2019 provides the pre-pandemic tourism expenditure and direct employment benchmarks, while the publicly available 2019 Kenya Nexus Social Accounting Matrix (SAM) provides the primary economy-wide production, factor income, institutional, and household consumption structures. Separate final-demand shocks are constructed for inbound and domestic tourism for 2020 and 2021, with both years measured relative to the 2019 benchmark. A 2021 Kenya Nexus SAM is used as an alternative structural specification to assess the sensitivity of the results to a more recent production structure.

The analysis estimates direct, indirect, and induced effects on gross output, factor value added, and labour income. Employment effects are estimated separately as direct tourism employment-equivalent contractions using product-specific employment intensities derived from the Kenya TSA 2019.

Study design and scope

The study adopts a comparative-static SAM multiplier design. The pre-pandemic reference year is 2019, and four tourism-demand scenarios are analysed: inbound tourism in 2020, domestic tourism in 2020, inbound tourism in 2021, and domestic tourism in 2021. The 2021 scenarios measure the remaining deviation from the 2019 benchmark and should therefore not be interpreted as incremental changes relative to 2020. The primary analysis uses the 2019 Kenya Nexus SAM. The same constructed final-demand vectors are subsequently applied to the 2021 Kenya Nexus SAM as a structural-sensitivity exercise. Holding the shocks constant across the two SAMs allows differences in multiplier results to reflect differences in the underlying economic structure rather than changes in shock assumptions.

Data sources and provenance

The analysis draws on four principal groups of official and openly accessible data.

First, the Kenya Tourism Satellite Account 2019 provides expenditure by tourism product and form of tourism, including separate inbound and domestic expenditure. In 2019, inbound tourism expenditure was KSh296.239 billion and domestic tourism expenditure was KSh343.300 billion, resulting in a total visitor expenditure benchmark of KSh639.539 billion. The TSA reports an additional KSh48.137 billion in other components of tourism consumption; because these components are not visitor expenditure, they are excluded from the constructed visitor-demand shock. The TSA also provides tourism-product ratios and direct tourism employment by industry, with total direct tourism employment estimated at 989,320 positions in 2019 (Tourism Research Institute, 2022b).

Second, the 2019 Kenya Nexus SAM is used as the primary multiplier database. It is expressed in billions of Kenyan shillings and is publicly available from IFPRI. The disseminated SAM contains 42 activities. Although its macroeconomic structure is aligned to the 2019 national accounts, its detailed I-O/SUT structure draws on the 2009 Kenya SUT; transaction margins and some commodity allocations also use the 2009 SUT. Accordingly, the 2019 SAM should be interpreted as a 2019 macroeconomic benchmark whose detailed production relationships partly reflect the 2009 SUT (IFPRI, 2021; Thurlow, 2021).

Third, the 2021 Kenya Nexus SAM, jointly produced by KIPPRA, KNBS, and IFPRI, is used for structural sensitivity analysis. It retains the standard 42-activity Nexus classification but updates the macroeconomic structure using 2021 national accounts and uses the 2016 KNBS SUT for its I-O/SUT structure, public consumption, capital formation, indirect tax rates, and transaction-cost margins (KIPPRA, KNBS, and IFPRI, 2023a, 2023b).

Fourth, annual shock indicators are drawn primarily from the Tourism Research Institute (TRI) and the Kenya National Bureau of Statistics (KNBS). TRI reports international arrivals of 2,048,834 in 2019, 567,848 in 2020, and 870,467 in 2021, and corresponding inbound tourism receipts of KSh296.201 billion, KSh88.562 billion, and KSh146.514 billion (Tourism Research Institute, 2022a). KNBS data provide product-related indicators such as resident and non-resident hotel bed nights, transport activity, visitation to national parks, museums, and heritage sites, and sectoral employment. For example, Kenyan-resident hotel bed nights declined from 4.047 million in 2019 to 2.567 million in 2020, then recovered to 3.830 million in 2021 (Kenya National Bureau of Statistics, 2022).

TSA-to-SAM concordance

Tourism is not represented as a single production activity in the SAM. TSA products were therefore mapped to the closest Nexus commodity/activity categories using the detailed ISIC correspondence. Accommodation and food-and-beverage services were assigned to the SAM accommodation-and-food-services account (chotl). Rail, road, water, and air passenger transport were assigned to the transportation and storage (ctran). Transport-equipment rental and travel-agency/reservation services were assigned to business services (cbsrv), while cultural and sports/recreational services were assigned to other services (cosrv), which include creative and arts activities, museums and other cultural activities, and sports and recreational activities (Thurlow, 2021; KIPPRA, KNBS, and IFPRI, 2023b).

The TSA residual categories, Valuables and Other, do not provide sufficient product detail for a unique SAM-sector match. They are therefore allocated using a transparent, author-defined rule based on 2019 marketed household consumption shares. Valuables are distributed across selected durable-goods commodities, while Other is distributed across the remaining eligible non-tourism consumption commodities. Because this allocation introduces additional uncertainty, a robustness scenario excludes both residual categories entirely.

Outcome variables and operational definitions

Three monetary outcomes and one employment outcome are examined.

- *Gross output* represents the total value of production generated across economic activities in response to the tourism final-demand shock.
- *Factor value added* represents labour, land, and capital factor incomes generated through production and corresponds to value added at factor cost within the SAM framework.
- *Labour income* represents earnings accruing to labour factors as production changes.

Direct tourism employment-equivalent contraction represents the number of 2019 tourism-supported positions associated with the specified tourism-demand contraction under fixed product-specific employment intensities. It is a modelling-equivalent measure and should not be interpreted as an observed headcount of workers dismissed. For monetary outcomes, direct effects represent the first-round domestic production response associated with the tourism final-demand shock. Indirect effects arise through interindustry purchases of intermediate inputs. Induced effects arise when changes in factor and household incomes alter household consumption, thereby generating additional production effects. Indirect and induced employment headcounts are not estimated because the public Nexus SAM records labour income rather than consistent physical worker counts across all 42 activities, and available national employment classifications cannot be mapped with sufficient precision to every SAM sector.

SAM multiplier framework and closure

The multiplier formulation follows the conventional unconstrained SAM multiplier framework (Breisinger et al., 2009). Let TE denote the SAM transaction submatrix for a specified set of endogenous accounts and yE the corresponding vector of endogenous account totals. The average expenditure-coefficient matrix is defined as:

$$A_E = T_E(\hat{y}_E)^{-1}$$

where $\hat{y}E$ is the diagonal matrix containing the endogenous account totals. The corresponding SAM multiplier matrix is:

$$M_E = (I - A_E)^{-1}$$

For an exogenous tourism final-demand shock vector Δf_E the change in endogenous account incomes is:

$$\Delta y_E = M_E \Delta f_E$$

A reduction in tourism demand is represented in the SAM as a negative final-demand injection. The replication files store the final reduction amounts using the convention that positive values denote contractions and negative values denote increases relative to 2019; the SAM solver therefore applies the opposite sign when constructing Δf_E. Thus, a contraction in tourism demand enters the model as a negative injection, whereas an increase above the 2019 benchmark enters as a positive injection.

The shock is entered as a negative demand injection into the relevant commodity accounts. Two model closures are estimated. Under the Type I closure, activities, commodities, and the transaction cost account are endogenous. Factor

accounts, households, enterprises, government, tax accounts, savings-investment, and the rest of the world remain exogenous. Under the *Type II/SAM closure*, factor and household accounts are additionally endogenized. Enterprises remain exogenous so that the induced component represents household-income and household-consumption feedback rather than additional enterprise-income recycling.

Because the initial shock enters commodity accounts, the first-round activity response under the Type I system is identified as the direct production effect. Operationally, the direct activity-output vector is the activity-account component of $A_I \triangle f_I$, while the Type I total activity-output vector is the activity-account component of $M_I \triangle f_I$, where A_I and M_I denote the coefficient and multiplier matrices under the Type I closure. The indirect activity effect is calculated as:

$$\Delta x^{\{Indirect\}} = \Delta x^{\{Type\,I\}} - \Delta x^{\{Direct\}}$$

The household-induced effect is:

$$\Delta x^{\{Induced\}} = \Delta x^{\{Type\,II\}} - \Delta x^{\{Type\,I\}}$$

The total activity effect is therefore:

$$\Delta x^{\{Total\}} = \Delta x^{\{Direct\}} + \Delta x^{\{Indirect\}} + \Delta x^{\{Induced\}}$$

Sector-specific value-added and labour-income coefficients are obtained from the SAM:

$$v_j = \frac{VA_j}{X_j}$$

and

$$l_j = \frac{LI_j}{X_j}$$

Where X_j denotes gross output of activity j, VA_j denotes total payments from activity j to all factor accounts, and LI_j denotes total payments from activity j to the labour-factor accounts. The value-added and labour-income coefficients are applied to the direct, indirect, and induced activity-output effects to estimate the corresponding factor-value-added and labour-income effects.

The SAM multiplier framework assumes fixed production coefficients, fixed relative expenditure patterns, no endogenous price adjustment, and no binding supply constraints. The resulting estimates are therefore interpreted as deterministic comparative-static effects conditional on the specified shocks and model structure, rather than as forecasts or causal elasticities (Breisinger et al., 2009).

Construction of the final-demand shocks

The 2019 TSA product expenditures form the pre-pandemic benchmark (Tourism Research Institute, 2022b). For tourism product i, visitor type v, and comparison year t, let $L_{\{i,v,t\}}$ denote the signed tourism-demand reduction amount:

$$L_{\{i,v,t\}} = E_{\{i,v,2019\}} d_{\{i,v,t\}}$$

Where $E_{\{i,v,2019\}}$ denotes the 2019 TSA expenditure benchmark for tourism product i and visitor type v, and $d_{\{i,v,t\}}$ denotes the proportional change expressed as a reduction relative to 2019. A positive value of $d_{\{i,v,t\}}$ denotes a contraction relative to 2019, whereas a negative value denotes an increase above the 2019 benchmark.

The corresponding signed final-demand injection entering the SAM is:

$$\Delta f_{\{i,v,t\}} = -L_{\{i,v,t\}}$$

Four separate shock vectors are constructed:

$$\Delta f^{IN}_{2020}, \Delta f^{DOM}_{2020}, \Delta f^{IN}_{2021}, \Delta f^{DOM}_{2021}$$

The 2021 vectors represent the remaining difference relative to 2019 rather than the change from 2020.

Inbound tourism shock construction

Where product-specific tourism expenditure series are unavailable, observable indicators of tourism activity are used to establish differences in shock severity across products. Accommodation uses non-resident hotel bed nights; air transport uses international airport passenger traffic; cultural services use museum and heritage-site visitation; sports and recreational services use non-resident foreign visitation to national parks; and international arrivals provide the general visitor-volume indicator for products for which no stronger product-specific series is available.

Because an official annual monetary series exists for total inbound tourism receipts, the product-specific proxy reductions are calibrated so that their expenditure-weighted average is consistent with the observed proportional contraction in aggregate inbound receipts. The observed proportional reduction in inbound receipts is:

$$d_t^{\{obs\}} = \frac{R_{2019} - R_t}{R_{2019}}$$

where R_t denotes observed aggregate inbound tourism receipts in year t and R_{2019} denotes the corresponding 2019 benchmark.

The 2019-inbound-expenditure-weighted average of the raw product-specific proxy reductions is:

$$\hat{d}_t^{proxy} = \frac{\sum_i E_{i,IN,2019} d_{i,IN,t}^{proxy}}{\sum_i E_{i,IN,2019}}$$

The calibration factor is therefore:

$$\lambda_t = \frac{d_t^{obs}}{\hat{d}_t^{proxy}}$$

and the calibrated product-specific inbound reduction is:

$$d^*_{i,IN,t} = \lambda_t d^{proxy}_{i,IN,t}$$

The resulting calibration factors are:

$$\lambda_{2020} = 0.9559, \lambda_{2021} = 0.8078$$

For inbound tourism, the calibrated rate $d^*_{i,IN,t}$ is used as the product-specific reduction rate in the shock construction described in Section 'SAM multiplier framework and closure'. This procedure preserves relative differences across tourism products while ensuring that the expenditure-weighted aggregate reduction is consistent with the observed proportional change in inbound tourism receipts (Tourism Research Institute, 2022a).

Table 1 TSA-to-SAM concordance used in the analysis.

TSA product	SAM commodity	SAM sector
Accommodation services	chotl	Accommodation and food services
Food and beverage serving services	chotl	Accommodation and food services
Railway passenger transport	ctran	Transportation and storage
Road passenger transport	ctran	Transportation and storage
Water passenger transport	ctran	Transportation and storage
Air passenger transport	ctran	Transportation and storage
Transport equipment rental	cbsrv	Business services
Travel agencies and reservation services	cbsrv	Business services
Cultural services	cosrv	Other services
Sports and recreational services	cosrv	Other services
Valuables	Residual allocation	Selected durable-goods commodities
Other consumption products	Residual allocation	Eligible non-tourism commodities

Domestic tourism shock construction

No equivalent comprehensive annual monetary series for total domestic tourism expenditure in 2020 and 2021 was identified in the reviewed official sources. Domestic product shocks are therefore constructed from explicitly identified activity indicators and treated as proxy-based deterministic scenarios rather than observed expenditure losses. Kenyan-resident hotel bed nights are used for accommodation and as a general proxy for domestic tourism when no stronger product-specific measure is available. Combined railway passenger journeys are used for rail transport, domestic airport passenger traffic for air transport, museum and heritage-site visitation for cultural services, and Kenyan-citizen national-park visitation for sports and recreational services (Kenya National Bureau of Statistics, 2022). Where a proxy is used, the supplementary shock-construction table identifies the indicator, its source, the calculated change relative to 2019, and the assumption involved. No activity-based proxy is presented as a direct observation of tourism expenditure.

Aggregation into SAM commodity shocks

Following the calculation at the TSA-product level, the shocks are aggregated to SAM commodity accounts according to the concordance in Table 1:

$$L_{s,v,t} = \sum\nolimits_i M_{is} L_{i,v,t}$$

The corresponding signed SAM commodity-level final-demand injection is:

$$\Delta f_{\{s,v,t\}} = -L_{\{s,v,t\}}$$

where M_{is} denotes the mapping weight assigning the TSA product i to the SAM commodity s. For direct one-to-one mappings, $M_{is} = 1$ for the corresponding commodity and 0 otherwise; for residual categories that require allocation across the relevant SAM commodities, the weights sum to one.

The detailed product-level values are retained in the replication workbook even when several TSA products are aggregated into the same SAM commodity. This preserves the calculation trail from the published TSA benchmark to the observed or proxy reduction to the final shock entering the SAM.

Employment estimation, sensitivity analysis and plausibility checks

Employment effects are estimated independently from the monetary SAM multiplier results. The Kenya TSA 2019 reports 989,320 tourism-direct positions, including employees and self-employed persons (Tourism Research Institute, 2022b).

For each tourism product i, a direct employment intensity is calculated as:

$$e_i = \frac{EMP_{i,2019}}{E^{IN}_{i,2019} + E^{DOM}_{i,2019}}$$

where EMPi, 2019 denotes direct tourism employment for product i, and the denominator is the sum of 2019 inbound and domestic visitor expenditure for that product.

The combined product-level tourism-demand reduction amount in year is:

$$L_{i,t} = L_{i,IN,t} + L_{i,DOM,t}$$

The corresponding direct tourism employment-equivalent effect is:

$$EMP^{\{eq\}}_{\{i,t\}} = e_i L_{i,t}$$

where $EMP^{eq}_{i,t}$ denotes the direct tourism employment-equivalent contraction for product i in year t.

The calculation assumes a fixed short-run relationship between tourism expenditure and tourism-supported employment. Accordingly, the resulting values are labelled direct tourism employment-equivalent contractions rather than observed job losses. Two formal robustness exercises are conducted. First, the complete set of constructed shocks is applied unchanged to both the 2019 and 2021 Kenya SAMs. The 2019 SAM uses a detailed structure derived from the 2009 SUT, whereas the 2021 SAM incorporates the 2016 SUT (Thurlow, 2021; KIPPRA, KNBS, and IFPRI, 2023b). This provides a direct test of structural sensitivity. Second, the multiplier analysis is repeated after excluding the TSA residual categories, Valuables and Other. This tests the extent to which the results depend on their author-defined SAM allocation.

Model results are also compared descriptively with official tourism and national-economic indicators, including observed tourism receipts, arrivals, hotel occupancy, transport activity, and employment changes. These comparisons are treated as plausibility checks rather than predictive or econometric validation. No standard errors or confidence intervals are reported because the SAM results are generated by deterministic accounting relationships rather than statistical sampling.

Data analysis and reproducibility

The empirical analysis proceeds sequentially from the TSA benchmark to final model outcomes. The 2019 TSA first establishes visitor expenditure by tourism product and visitor type. The tourism products are then mapped to the Nexus SAM commodity classification. Official 2020 and 2021 tourism indicators are converted into documented product-specific reduction rates, after which separate inbound and domestic final-demand vectors are constructed for each year.

The shock vectors are applied to the 2019 SAM under Type I and Type II closures to calculate direct, indirect, and induced activity-output effects. Sectoral factor-value-added and labour-income coefficients are then applied to the activity-output results. Direct tourism employment-equivalent effects are calculated separately using TSA employment intensities. Finally, two robustness exercises are conducted. First, the same 2019-based reduction vectors, and therefore the same corresponding signed final-demand injection vectors, are applied unchanged to the 2021 SAM to assess structural sensitivity. Second, the primary 2019 SAM multiplier analysis is repeated after excluding the TSA residual categories, Valuables and Other, to assess sensitivity to their allocation across SAM commodities. All monetary shock and SAM results are reported in KSh billion unless otherwise stated. Shock magnitudes are expressed relative to the 2019 tourism-expenditure benchmark. Accordingly, the 2021 estimates represent the

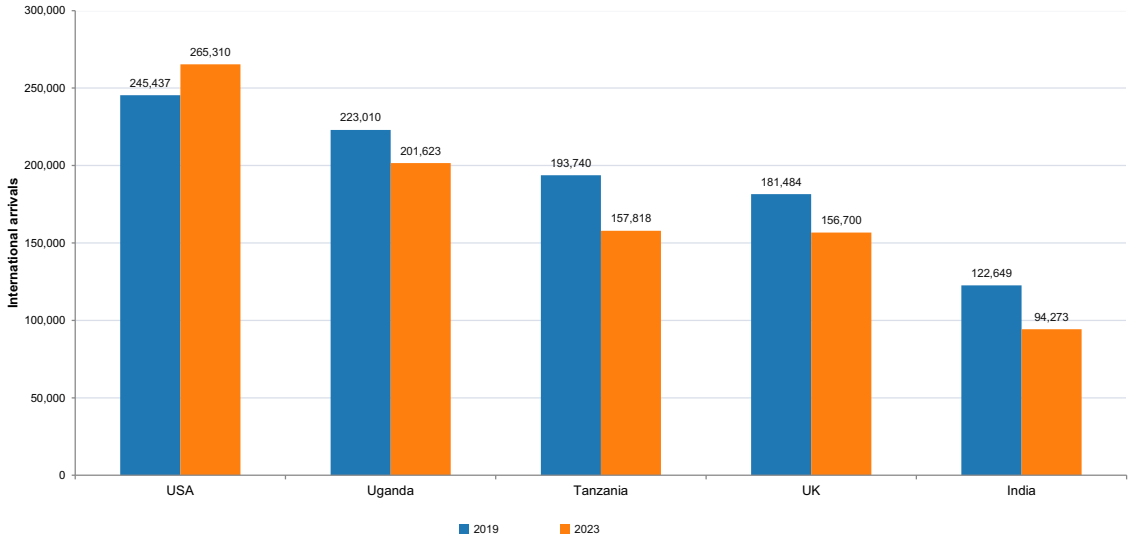

Fig. 1 Top five source markets for Kenya in 2019 and 2023. The figure compares Kenya's leading international tourism source markets before and after the COVID-19 shock, showing changes in arrivals from the USA, Uganda, Tanzania, the UK, and India. Source: Tourism Research Institute (2024), Tourism Sector Performance Report 2023; Tourism Research Institute (2022b).

remaining deviation from the 2019 benchmark rather than incremental changes relative to 2020. The use of annual percentage changes does not imply that a dynamic or intertemporal model is estimated.

The publicly disseminated 2019 SAM contains rounded monetary entries. The calculations use the published SAM account totals as denominators when constructing the expenditure-coefficient matrices and do not retrospectively rebalance or otherwise alter the public matrix. The accompanying replication package contains the publicly disseminated 2019 and 2021 Kenya SAM matrices, the TSA-to-SAM concordance, source indicators, complete product-level shock calculations, four final-demand shock vectors, SAM closure specifications, multiplier results, direct tourism employment-equivalent calculations, structural-sensitivity results, residual-category robustness results, and executable replication code. These materials allow the reported model results to be reproduced from the published 2019 TSA benchmark and observed tourism indicators.

Results

The results are presented in three stages. First, the observed disruption in tourism activity and the constructed final-demand shocks are reported. Second, the 2019 Kenya SAM is used to estimate direct, indirect, and induced effects on gross output, factor value added, and labour income, together with direct tourism employment-equivalent effects. Third, the robustness of the results is evaluated using the alternative 2021 Kenya SAM structure and a residual-category exclusion specification. All 2020 and 2021 estimates are expressed relative to the 2019 pre-pandemic benchmark; the 2021 estimates, therefore, represent the remaining shortfall relative to 2019 rather than incremental changes from 2020.

Observed tourism shock and recovery

Kenya experienced a severe contraction in international tourism in 2020, followed by a partial recovery in 2021. International visitor arrivals declined from 2,048,834 in 2019 to 567,848 in 2020, before recovering to 870,467 in 2021. Inbound tourism receipts similarly declined from KSh296.201 billion in 2019 to KSh88.562 billion in 2020, before increasing to KSh146.514 billion in 2021 (Tourism Research Institute, 2022a). These changes correspond to

Table 2 Tourism final demand shocks relative to the 2019 benchmark.

Tourism component	2019 benchmark (KSh bn)	2020 shock (KSh bn)	2020 change	2021 shock (KSh bn)	2021 change
Inbound tourism	296.239	−207.666	−70.1%	−149.707	−50.5%
Domestic tourism	343.300	−131.107	−38.2%	−24.499	−7.1%
Combined visitor expenditure	639.539	−338.774	−53.0%	−174.206	−27.2%

Source: Kenya TSA 2019; Tourism Research Institute and KNBS indicators; authors' calculations.

an approximately 70.1% contraction in inbound tourism receipts in 2020 and a remaining 50.5% shortfall in 2021 relative to 2019. The official TRI series confirms these arrival and receipt values. Domestic tourism demonstrated a substantially faster recovery. Hotel bed nights occupied by Kenyan residents declined from 4.047 million in 2019 to 2.567 million in 2020, then recovered to 3.830 million in 2021 (Kenya National Bureau of Statistics, 2022). KNBS reports that resident hotel bed nights increased by 49.2% between 2020 and 2021 and accounted for 69.4% of total occupied hotel bed nights in 2021 (Kenya National Bureau of Statistics, 2022). This divergence between international and domestic recovery provides the empirical basis for modelling inbound and domestic tourism separately.

Figure 1 provides additional descriptive context on changes in Kenya's principal international source markets between the pre-pandemic period and the subsequent recovery. These source-market statistics are not used in constructing the SAM shock vectors, which rely on the aggregate and product-specific 2019–2021 indicators described in Section 3.5.

Tourism final-demand shocks

The Kenya Tourism Satellite Account 2019 provides the pre-pandemic benchmark from which the tourism-demand shocks are constructed. TSA Table 2 reports aggregate inbound visitor expenditure of KSh296.239 billion and domestic visitor expenditure of KSh343.300 billion, producing combined inbound and domestic visitor expenditure of KSh639.539 billion (Tourism Research Institute, 2022b). Product-level TSA expenditures were combined with the annual tourism indicators described in Section 3.5 to construct separate inbound and domestic final-demand vectors for 2020 and 2021.

The inbound tourism vector is anchored to the observed annual tourism receipts series. Official data from the Tourism Research Institute show inbound receipts of KSh296.201 billion in 2019, KSh88.562 billion in 2020, and KSh146.514 billion in 2021 (Tourism Research Institute, 2022a). Product-specific inbound proxy reductions were therefore calibrated so that their weighted aggregate reproduced the observed proportional reduction in inbound receipts. An equivalent comprehensive annual monetary series for total domestic tourism expenditure in 2020 and 2021 was not identified in the reviewed official sources. Domestic shocks were therefore constructed using the explicitly identified product-level activity indicators described in Section 'SAM multiplier framework and closure'. Accordingly, the domestic estimates are interpreted as proxy-based deterministic demand scenarios rather than directly observed expenditure losses. The combined visitor-demand contraction amounted to approximately KSh338.774 billion in 2020 and KSh174.206 billion in 2021. Product-level calculation details, including the 2019 baseline, indicator, percentage reduction, calibration, final monetary shock, and corresponding SAM commodity, are provided in the Supplementary Information and replication materials. The replication materials also provide the commodity-level numerical values of the final-demand vectors, including zero entries for unaffected SAM commodities.

Table 3 Economy-wide effects using the 2019 Kenya SAM KSh billion contractions.

Outcome	Direct	Indirect	Induced	Total
2020				
Gross output	287.214	217.818	265.734	770.766
Factor value added	122.700	121.566	151.852	396.119
Labour income	41.411	43.807	52.957	138.175
2021				
Gross output	149.746	118.388	140.639	408.772
Factor value added	60.160	66.219	80.380	206.759
Labour income	20.822	24.184	28.034	73.039

Authors' calculations using the final-demand vectors and 2019 Kenya Nexus SAM.

Table 4 Gross-output effects by form of tourism KSh billion contractions.

Scenario	Direct	Indirect	Induced	Total
Inbound 2020	178.202	145.475	169.937	493.615
Domestic 2020	109.012	72.342	95.797	277.151
Inbound 2021	128.648	105.575	122.064	356.287
Domestic 2021	21.097	12.813	18.574	52.485

Authors' calculations using the 2019 Kenya Nexus SAM.

Economy-wide multiplier effects

Applying the final-demand vectors to the 2019 Kenya SAM reveals substantial economic effects beyond the initial reduction in tourism expenditure. Table 3 reports the estimated direct, indirect, induced, and total effects on gross output, factor value added, and labour income.

The KSh338.774 billion contraction in visitor demand in 2020 is associated with an estimated KSh770.766 billion contraction in economy-wide gross output after accounting for interindustry and household consumption effects. The corresponding total-output-to-final-demand ratio is approximately 2.28. For 2021, the remaining KSh174.206 billion visitor-demand shortfall is associated with an estimated KSh408.772 billion gross-output contraction, corresponding to a total-output-to-final-demand ratio of approximately 2.35. These ratios represent comparative-static multiplier relationships and should not be interpreted as causal elasticities or economic forecasts. The decomposition also shows that much of the economy-wide effect occurs beyond the first-round production response. In 2020, direct gross output effects amounted to KSh287.214 billion, while indirect and induced effects together totalled approximately KSh483.552 billion. This demonstrates how a contraction in tourism demand propagates through supplier relationships and household consumption linkages.

Inbound versus domestic tourism effects

The analysis also allows the economy-wide effects of inbound and domestic tourism to be compared using the same model structure (Table 4).

Inbound tourism produced the larger economy-wide contraction in both years. In 2020, the inbound tourism shock generated an estimated KSh493.615 billion total gross-output contraction, equivalent to approximately 64.0% of the combined tourism-related gross-output effect. The corresponding domestic tourism effect was approximately KSh277.151 billion. The difference became considerably larger by 2021. Inbound tourism accounted for approximately 87.2% of the remaining modelled gross-output shortfall, with an estimated KSh356.287 billion effect compared with KSh52.485 billion for domestic tourism. This pattern is consistent with the observed recovery of domestic hotel activity. Kenyan-resident hotel bed nights recovered from 2.567 million in 2020 to 3.830 million in 2021,

Table 5 Activities with the largest total gross-output contractions in 2020.

SAM activity	Gross-output contraction (KSh bn)
Transportation and storage	174.179
Accommodation and food services	117.424
Wholesale and retail trade	45.964
Processed foods	45.614
Business services	40.051
Cattle and raw milk	28.056
Maize	25.614
Real estate	24.416
Pulses	20.895
Other services	20.285

Authors' calculations using the 2019 Kenya Nexus SAM.

reaching approximately 94.6% of their 2019 level. In contrast, international arrivals and inbound receipts remained substantially below 2019 levels in 2021 (Kenya National Bureau of Statistics, 2022; Tourism Research Institute, 2022a). The results, therefore, suggest that domestic tourism acted as an important partial buffer during the recovery period.

Sectoral transmission of the tourism shock

The effects of reduced tourism demand extended beyond tourism-specific industries, as accommodation, food services, transportation, and other visitor-facing activities purchase goods and services from upstream industries. Table 5 reports the ten SAM activities experiencing the largest total gross-output contractions under the combined 2020 shock.

Transportation and storage experienced the largest modelled output contraction, followed by accommodation and food services. However, sizeable effects also occurred in wholesale and retail trade, processed foods, business services, livestock, crop production, and real estate. The results demonstrate how reduced tourism expenditure is transmitted upstream through intermediate-input demand. Accommodation and food-service businesses, for example, purchase agricultural products, processed foods, transport services, utilities, and other business inputs. A reduction in visitor demand, therefore, affects producers that are not themselves classified as tourism industries. By 2021, the estimated contractions in transportation and storage and accommodation and food services had narrowed to approximately KSh80.9 billion and KSh75.5 billion, respectively, although both remained among the activities most strongly affected by the remaining tourism-demand shortfall (Fig. 2).

Direct tourism employment-equivalent effects

The employment analysis is estimated separately from the monetary SAM multiplier effects (Table 6). The Kenya TSA 2019 identifies approximately 989,320 direct tourism-supported positions, including employees and self-employed workers (Tourism Research Institute, 2022b). Food and beverage services, road passenger transport, and accommodation account for the largest shares of direct tourism employment. Product-specific TSA employment intensities were applied to the product-level demand shocks to estimate the direct employment associated with the contraction in tourism expenditure.

The 2020 tourism-demand shock corresponds to approximately 507,974 direct tourism employment-equivalent positions, representing about 51.3% of the 2019 direct tourism employment benchmark. The corresponding 2021 shortfall is approximately 248,990 positions, or about 25.2% of the 2019 benchmark. Accommodation and food services account for the largest employment-equivalent contraction, followed by transportation (Fig. 3).

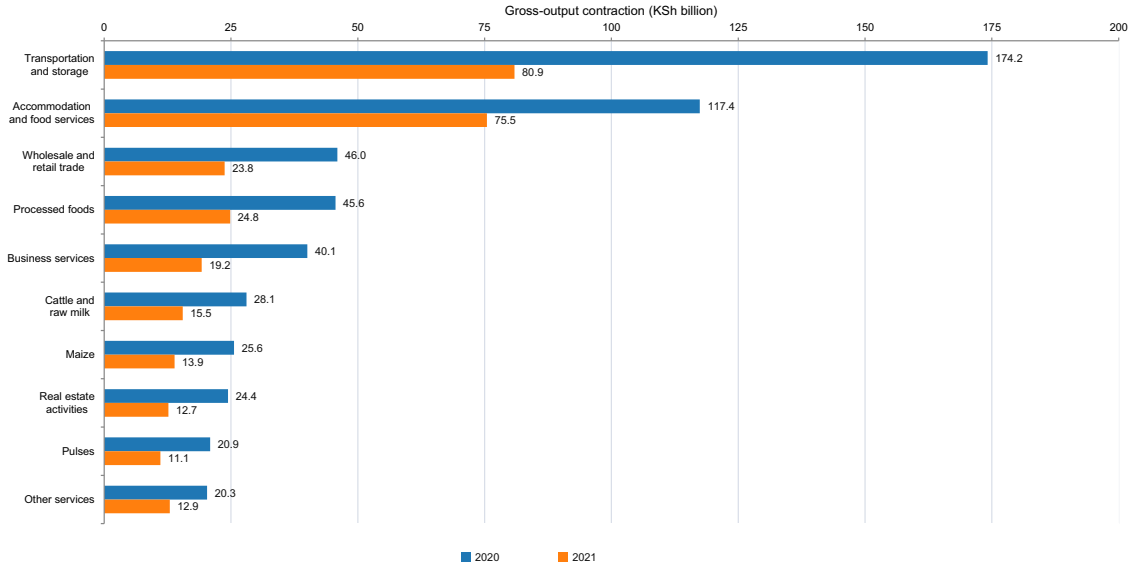

Fig. 2 Sectoral gross-output contractions associated with the tourism-demand shock, 2020 and 2021. The figure compares the estimated total gross-output contractions across the principal affected SAM activities under the combined tourism-demand shocks for 2020 and 2021, relative to the 2019 benchmark. Transportation and storage, accommodation and food services show the largest contractions, while sizeable effects also extend to wholesale and retail trade, processed foods, business services, agriculture, real estate, and other services. Values are reported in KSh billion. Source: Authors' calculations using the 2019 Kenya Nexus SAM.

The considerably smaller domestic tourism shortfall in 2021 contributes to the substantial reduction in the overall employment-equivalent effect relative to 2020. These values should not be interpreted as observed layoffs. They represent the number of 2019 tourism-supported positions associated with the reconstructed expenditure contraction under fixed product-specific employment intensities. Actual labour-market adjustment may also have occurred through reduced working hours, wage changes, temporary closures, unpaid leave, losses in self-employment, and other mechanisms.

Structural sensitivity and robustness

The sensitivity of the results to the underlying economic structure was assessed by applying the same final-demand vectors to the 2021 Kenya Nexus SAM (Table 7). The primary 2019 SAM is aligned to 2019 macroeconomic accounts but derives its detailed I–O/SUT structure from the 2009 Kenya SUT, whereas the 2021 Kenya SAM incorporates the more recent 2016 SUT (Thurlow, 2021; KIPPRA, KNBS, and IFPRI, 2023b). The use of identical shocks in both models allows differences in results to be attributed to the underlying economic structure rather than to different tourism-demand assumptions.

The alternative 2021 SAM structure produces gross-output effects approximately 10-11% lower than the primary estimates and factor-value-added effects approximately 6-7% lower. Labour-income effects are more structurally sensitive, declining by approximately 28% under the alternative specification. Despite these differences in magnitude, the direction of the effects and the principal sectoral pattern remain unchanged. The sensitivity analysis, therefore, indicates that the principal conclusions are qualitatively robust, although the precise magnitude of labour-income transmission depends more strongly on the economic structure represented in the SAM (Fig. 4).

A second robustness test examines the treatment of the TSA residual categories Valuables and Other, for which no unique one-to-one SAM commodity mapping is available. When these categories are excluded entirely rather than allocated across SAM commodities, the estimated total gross output contraction falls from KSh770.766 billion to KSh658.940 billion in 2020, and from KSh408.772 billion to KSh366.549 billion in 2021. These differences correspond to reductions of approximately 14.5% and 10.3%, respectively. Although excluding the residual

Table 6 Direct tourism employment-equivalent contractions.

Tourism group	2019 direct tourism employment	2020 contraction	2021 contraction
Accommodation and food services	574,126	330,008	194,126
Transportation	366,674	149,959	39,599
Business services	23,058	9,407	2,469
Cultural & recreational services	25,462	18,599	12,797
Total	989,320	507,974	248,990

Authors' calculations based on Kenya TSA 2019 employment and expenditure data and the reconstructed shocks.

categories lowers the estimated magnitudes, the direction of the results and the dominant sectoral ranking remain unchanged. Full results from this robustness specification are reported in the Supplementary Information and replication package.

Recovery pattern and resilience of domestic tourism

The annual results reveal substantially different recovery trajectories for inbound and domestic tourism. The domestic tourism final-demand shortfall declines from approximately KSh131.1 billion in 2020 to KSh24.5 billion in 2021. By contrast, the inbound tourism shortfall decreases from approximately KSh207.7 billion to KSh149.7 billion, leaving international tourism as the dominant source of the remaining tourism-related economic contraction in 2021. The observed tourism indicators are consistent with this pattern. Hotel bed nights occupied by Kenyan residents increased by 49.2%, from 2.567 million in 2020 to 3.830 million in 2021, and accounted for 69.4% of total hotel bed-night occupancy in 2021 (Kenya National Bureau of Statistics, 2022). By contrast, international arrivals reached only 870,467 in 2021 compared with 2,048,834 in 2019, while inbound tourism receipts of KSh146.514 billion remained approximately 50.5% below their 2019 level (Tourism Research Institute, 2022a). The results, therefore, identify domestic tourism as an important partial resilience mechanism. Its faster recovery substantially reduced the domestic component of the tourism-demand shock by 2021, although domestic demand was insufficient to offset the economic contribution associated with the prolonged contraction in international tourism.

Discussion

The analysis demonstrates that the COVID-19 tourism-demand shock in Kenya generated substantial economic effects beyond the industries that directly serve visitors. By linking the Kenya Tourism Satellite Account 2019 to the Kenya Nexus Social Accounting Matrix, the study traces how separate shocks to inbound and domestic tourism are transmitted through production networks, factor incomes, and household consumption. The results also reveal substantially different recovery trajectories between inbound and domestic tourism and show that, although the principal findings are robust to alternative structural assumptions, the absolute magnitude of some effects, particularly labour income, is sensitive to the economic structure represented in the SAM.

The combined visitor-demand contraction amounted to approximately KSh338.8 billion in 2020 and KSh174.2 billion in 2021, relative to the 2019 benchmark. Under the primary 2019 SAM specification, these shocks correspond to total gross-output contractions of approximately KSh770.8 billion in 2020 and KSh408.8 billion in 2021. The corresponding factor-value-added effects were approximately KSh396.1 billion and KSh206.8 billion, while labour-income effects were approximately KSh138.2 billion and KSh73.0 billion. These findings demonstrate that assessing only the initial decline in visitor expenditure would substantially understate the wider economic exposure associated with the tourism shock.

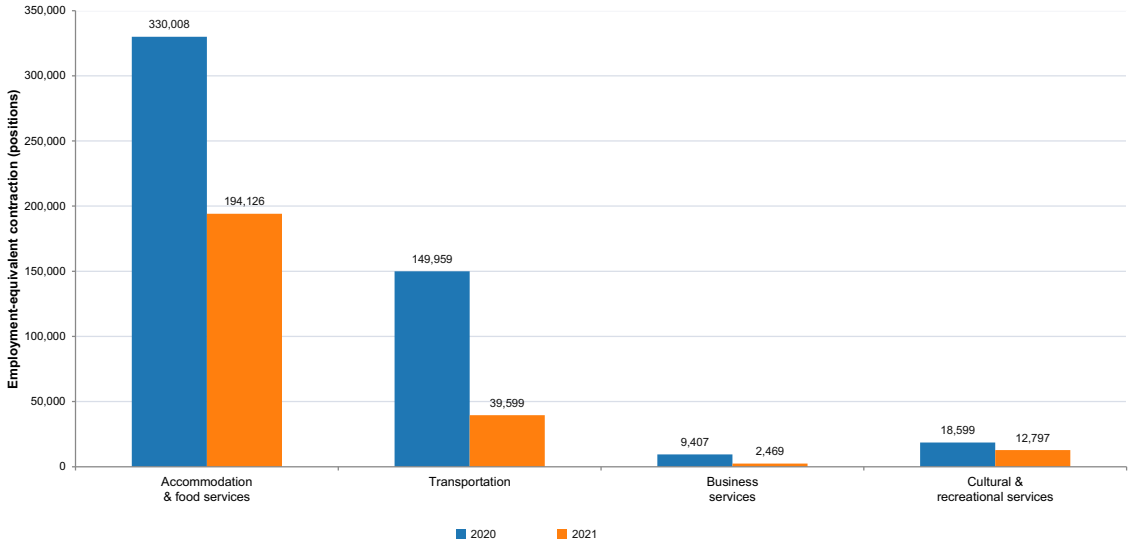

Fig. 3 Direct tourism employment-equivalent contractions by tourism group, 2020 and 2021. The figure compares the estimated direct tourism employment-equivalent contractions across accommodation and food services, transportation, business services, and cultural and recreational services. The estimates are derived by applying 2019 TSA product-specific employment intensities to the reconstructed tourism-demand shocks. They represent employment-equivalent positions associated with the reduction in tourism expenditure and should not be interpreted as observed layoffs or indirect and induced job losses. Source: Authors' calculations based on Kenya TSA 2019 employment data and reconstructed tourism-demand shocks.

Economy-wide transmission and structural vulnerability

The magnitude of the economy-wide effects illustrates the importance of interindustry and household linkages in transmitting tourism shocks. In 2020, a KSh338.8 billion visitor-demand contraction was associated with approximately KSh770.8 billion in total gross-output effects, corresponding to a total-output-to-final-demand ratio of approximately 2.28. The equivalent ratio for the 2021 remaining shortfall was approximately 2.35. These ratios are comparative-static multiplier relationships rather than causal elasticities or forecasts. Importantly, a large proportion of the estimated effect occurred beyond the first-round production response. Direct gross-output effects amounted to approximately KSh287.2 billion in 2020, whereas indirect and induced effects together amounted to approximately KSh483.6 billion. The findings therefore reinforce the basic logic of input–output and SAM multiplier analysis: a contraction in final demand affects not only businesses selling directly to visitors but also their suppliers, factor-income recipients, and households whose consumption depends on those incomes. This interpretation is consistent with previous tourism multiplier studies using input–output and SAM approaches (Akkemik, 2012; Jones, 2010; Polo and Valle, 2009; Tchouamou Njoya, 2022).

The result also illustrates an important dimension of structural vulnerability. Strong intersectoral linkages enhance tourism's contribution to economic activity during periods of growth, but the same relationships can amplify losses when tourism demand contracts. Tourism linkages should therefore be interpreted simultaneously as a source of economic contribution and a channel through which external shocks can propagate.

Inbound tourism as the principal source of vulnerability

The separation of inbound and domestic tourism reveals that inbound demand was the principal source of Kenya's prolonged tourism-related economic contraction. In 2020, the shock to inbound tourism generated an estimated KSh493.6 billion in total gross output effects, compared with approximately KSh277.2 billion for domestic tourism. Inbound tourism, therefore, accounted for approximately 64.0% of the combined modelled gross-output effect. The difference became substantially larger in 2021. The remaining inbound-related gross-output effect was approximately KSh356.3 billion, compared with only KSh52.5 billion for domestic tourism. Inbound tourism consequently

Table 7 Structural sensitivity: 2019 versus 2021 Kenya SAM.

Outcome	2019 SAM	2021 SAM	Difference
2020 shock			
Gross output	770.766	687.617	−10.8%
Factor value added	396.119	368.169	−7.1%
Labour income	138.175	99.457	−28.0%
2021 shock			
Gross output	408.772	367.939	−10.0%
Factor value added	206.759	194.262	−6.0%
Labour income	73.039	52.881	−27.6%

Authors' calculations using the 2019 and 2021 Kenya Nexus SAMs.

Monetary effects are KSh billion. The same 2019-based tourism-demand shock vectors are applied to both SAM structures; the 2021 SAM exercise therefore represents structural sensitivity rather than a re-estimation of the monetary shock using a 2021 baseline.

accounted for approximately 87.2% of the remaining modelled gross-output shortfall. The official tourism statistics support this interpretation. International visitor arrivals declined from 2,048,834 in 2019 to 567,848 in 2020 and recovered to only 870,467 in 2021. Inbound receipts similarly declined from KSh296.201 billion to KSh88.562 billion, then recovered to KSh146.514 billion (Tourism Research Institute, 2022a). Thus, international tourism remained substantially below its pre-pandemic level even after the initial reopening and recovery had begun.

This finding is consistent with the broader literature on the vulnerability of tourism-dependent African economies to international mobility restrictions and external-demand shocks (Henseler et al., 2022; van der Merwe et al., 2021; Tahanout and Berkane, 2021). In the Kenyan case, reliance on international markets and international connectivity increased exposure to a shock originating outside the domestic economy.

Domestic tourism as a partial resilience mechanism

The faster recovery of domestic tourism represents one of the clearest indications of resilience in the results. The domestic tourism final-demand shortfall declined from approximately KSh131.1 billion in 2020 to KSh24.5 billion in 2021. Its associated total gross-output effect consequently declined from approximately KSh277.2 billion to KSh52.5 billion. Observed hotel activity is consistent with this pattern. Hotel bed nights occupied by Kenyan residents declined from 4.047 million in 2019 to 2.567 million in 2020, then recovered to 3.830 million in 2021. KNBS reports that resident bed nights increased by 49.2% between 2020 and 2021 and represented 69.4% of total occupied hotel bed nights in 2021 (Kenya National Bureau of Statistics, 2022).

The results, therefore, support the interpretation of domestic tourism as a partial buffer rather than a complete substitute for inbound tourism. Domestic demand helped sustain tourism-related activity while international mobility remained depressed, but it could not fully replace the scale and expenditure associated with international visitors. This finding is consistent with studies highlighting the resilience potential of domestic tourism during external disruptions (Volgger et al., 2021; Wu et al., 2022). In Kenya, it also reinforces the argument that strengthening participation in domestic tourism can broaden the sector's demand base and reduce dependence on international markets (Kifworo et al., 2020; Osiako and Szente, 2021).

Sectoral transmission beyond tourism-characteristic industries

Transportation, storage, accommodation, and food services recorded the largest modelled gross-output contractions, which is consistent with the direct effects of mobility restrictions and reduced visitor activity. Under the combined 2020 shock, transportation and storage experienced an estimated KSh174.2 billion contraction in total output, while accommodation and food services experienced an estimated KSh117.4 billion contraction. However, the economic effects extended well beyond conventionally defined tourism activities. Wholesale and retail trade recorded an

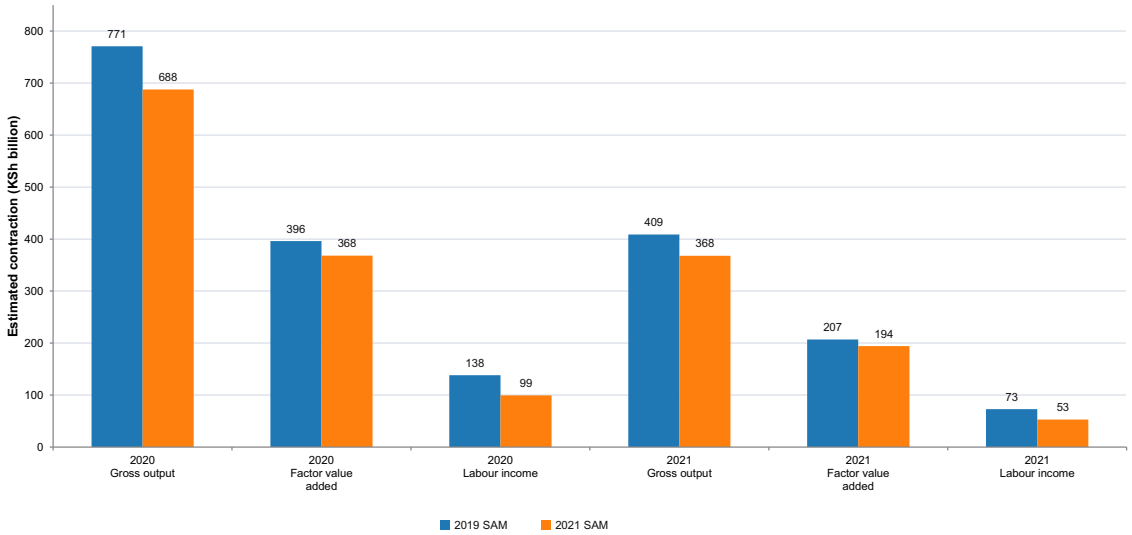

Fig. 4 Sensitivity of gross-output, factor-value-added, and labour-income effects to the 2019 and 2021 Kenya SAM structures. The figure compares the estimated contractions in gross output, factor-value added, and labour income obtained when the 2019-based tourism-demand shock vectors are applied to the 2019 and 2021 Kenya Nexus SAM structures. The 2021 SAM produces lower estimated effects, particularly for labour income, while preserving the overall direction of the results. The comparison, therefore, represents structural sensitivity rather than a re-estimation of the tourism shocks using a 2021 baseline. Values are reported in KSh billion. Source: Authors' calculations using the 2019 and 2021 Kenya Nexus SAMs.

estimated KSh46.0 billion contraction, processed foods KSh45.6 billion, and business services KSh40.1 billion. Sizeable effects were also observed in cattle, raw milk, maize, pulses, and real estate. These upstream effects demonstrate the importance of tourism supply chains. Hotels, restaurants, transportation providers, and other visitor-facing businesses purchase food, agricultural products, manufactured goods, financial and business services, and other intermediate inputs. Reduced visitor expenditure, therefore, exerts economic pressure on producers who may themselves not be regarded as tourism enterprises.

This finding is consistent with previous work emphasising tourism's interindustry and supply-chain linkages in African economies (Chidakel et al., 2021; Jones, 2010). It also suggests that tourism crisis-response policies focused exclusively on hotels, airlines, or tour operators may overlook economically exposed suppliers further upstream.

Employment implications

The employment analysis provides an estimate of direct labour-market exposure based on TSA employment intensities. The Kenya TSA 2019 identifies 989,320 direct tourism-supported positions, including both employees and self-employed workers (Tourism Research Institute, 2022b). Applying product-specific TSA employment intensities to the tourism-demand shocks produces an estimated 507,974 direct tourism employment-equivalent contraction in 2020 and approximately 248,990 in 2021. Accommodation and food services account for the largest employment-equivalent effect, followed by transportation. The substantial reduction in the estimated employment-equivalent shortfall between 2020 and 2021 is consistent with the broader recovery in domestic tourism activity.

These estimates should not be interpreted as the actual number of workers dismissed during the pandemic. Rather, they measure the amount of 2019 tourism-supported employment associated with the estimated reduction in visitor expenditure under fixed product-specific employment intensities. Firms and workers could have adjusted by reducing hours, lowering earnings, temporarily closing, taking unpaid leave, changing informal employment arrangements, or other means. This distinction is particularly important because the TSA employment benchmark includes both employees and self-employed workers. Direct employment-equivalent estimates, therefore, provide an indication of labour exposure without imposing unsupported indirect and induced employment headcounts.

Structural sensitivity and robustness of the estimates

The structural-sensitivity analysis assesses how the estimated multiplier effects depend on the economic structure represented in the SAM. The primary 2019 Kenya SAM is aligned to the 2019 macroeconomic structure but uses the 2009 SUT as an important source for its detailed production relationships. The alternative 2021 Kenya SAM incorporates the more recent 2016 SUT (Thurlow, 2021; KIPPRA, KNBS, and IFPRI, 2023b). Applying the same tourism-demand vectors to both structures, therefore, provides a direct assessment of how the estimated multiplier effects depend on the economic structure represented in the model. Under the 2021 SAM structure, the estimated total gross-output effect of the 2020 shock decreases from KSh770.8 billion to KSh687.6 billion, a difference of approximately 10.8%. For the 2021 shock, the estimated gross-output effect declines from KSh408.8 billion to KSh367.9 billion, a difference of approximately 10.0%. Factor-value-added effects are approximately 6-7% lower under the alternative structure.

Labour-income effects are more sensitive. The alternative specification yields labour-income estimates approximately 28% lower than those from the primary 2019 SAM. This indicates that conclusions concerning the direction and sectoral concentration of the tourism shock are relatively robust, while the absolute magnitude of income transmission depends more strongly on the underlying factor-income structure. The residual expenditure robustness test leads to a similar conclusion. Excluding the TSA categories Valuables and Other reduces the total gross output effect from KSh770.8 billion in 2020 to KSh658.9 billion, and from KSh408.8 billion in 2021 to KSh366.5 billion. Although the magnitudes decline, the principal direction and sectoral ranking remain unchanged. These findings strengthen the interpretation of the model by distinguishing results that are relatively stable across specifications from magnitudes that depend more strongly on structural and allocation assumptions.

Environmental and social implications

The economic effects identified by the SAM also have broader environmental and social implications, although these are not quantified directly by the present model. Previous research indicates that reductions in visitor activity can temporarily reduce human pressure on protected areas while simultaneously weakening tourism-derived conservation financing and livelihood opportunities in tourism-dependent communities (Anand and Kim, 2021; Kitamura et al., 2020; Chebby et al., 2024). This creates an important policy tension for destinations in which nature-based tourism contributes to both conservation financing and household livelihoods. When visitor revenues collapse, protected areas and surrounding communities may face financial pressures even where temporary reductions in tourism activity provide some ecological relief.

The pandemic, therefore, reinforces the importance of diversifying conservation financing rather than relying excessively on visitor revenue alone. Potential mechanisms discussed in the literature include public financing, conservation levies, partnerships with the private sector, and locally anchored livelihood opportunities. These considerations complement the economic findings of this study but should be interpreted as broader implications from the literature rather than output produced by the SAM analysis.

Theoretical implications

The findings contribute to three related theoretical perspectives: First, they provide empirical support for the multiplier and economic interdependence theory. Tourism expenditure does not remain confined to tourism-characteristic activities; it is transmitted through supplier relationships, factor payments, and household consumption. The substantial indirect and induced effects identified in the analysis illustrate how tourism demand interacts with the wider production system. Second, the findings contribute to perspectives on tourism dependency and structural vulnerability. The strong and persistent effect of inbound tourism demonstrates how reliance on external visitor markets can expose an economy to shocks originating outside national boundaries. Interindustry linkages that enhance tourism's contribution in normal periods can simultaneously magnify economic losses when external demand contracts. Third,

the results support a resilience perspective in which recovery is heterogeneous rather than uniform. Domestic tourism recovered considerably faster than inbound tourism, demonstrating that resilience depends in part on the composition of demand and on the capacity of domestic markets to sustain activity when international mobility is disrupted. Domestic tourism did not entirely replace international expenditure, but it reduced the persistence of the overall tourism shock.

The structural-sensitivity results add a methodological dimension to these theoretical implications. The main conclusions concerning direction and sectoral concentration remain stable across alternative SAM structures, whereas some absolute magnitudes, particularly labour-income effects, change materially. Tourism vulnerability and resilience estimates should therefore be interpreted as conditional on both the external shock and the structure through which that shock is transmitted.

Conclusions and policy implications

This study estimated the economy-wide consequences of the COVID-19 tourism-demand shock in Kenya using a transparent Tourism Satellite Account-Social Accounting Matrix framework. By linking the Kenya Tourism Satellite Account 2019 to the publicly available 2019 Kenya Nexus SAM, the analysis distinguishes inbound and domestic tourism shocks in 2020 and 2021 and traces their direct, indirect, and induced effects through production networks, factor incomes, and household consumption. The combined visitor-demand contraction amounted to approximately KSh338.8 billion in 2020 and KSh174.2 billion in 2021, relative to the 2019 benchmark. Under the primary 2019 SAM specification, these shocks correspond to estimated economy-wide gross-output contractions of approximately KSh770.8 billion in 2020 and KSh408.8 billion in 2021. The associated factor-value-added effects were approximately KSh396.1 billion and KSh206.8 billion, respectively, while the labour-income effects were approximately KSh138.2 billion and KSh73.0 billion, respectively.

The findings demonstrate that the economic consequences of the tourism shock extended substantially beyond visitor-facing industries. Transportation, storage, accommodation, and food services experienced the largest output effects, but sizeable contractions were also transmitted to wholesale and retail trade, processed foods, business services, livestock, crop production, and real estate. Tourism's economic significance, therefore, lies not only in the expenditure occurring within tourism-characteristic industries but also in its extensive connections with the wider production system. The analysis further reveals substantially different recovery trajectories for inbound and domestic tourism. Inbound tourism accounted for approximately 64.0% of the combined modelled gross-output contraction in 2020 and approximately 87.2% of the remaining gross-output shortfall in 2021. Domestic tourism recovered considerably faster, consistent with the strong rebound in Kenyan-resident hotel bed nights. Domestic tourism should therefore be understood as an important partial resilience mechanism, although it was not sufficient to replace the scale of expenditure associated with the prolonged contraction in international tourism.

The direct employment analysis produces a similarly important conclusion. The estimated demand contraction corresponds to approximately 507,974 direct tourism employment-equivalent positions in 2020 and 248,990 positions in 2021. These estimates represent tourism-supported employment associated with the contraction in demand under fixed 2019 employment intensities and should not be interpreted as observed layoffs. This distinction is particularly relevant in Kenya, where tourism employment includes both employees and self-employed workers.

The structural sensitivity analysis provides evidence on the robustness of the principal conclusions while demonstrating the importance of the model structure. Applying the same tourism-demand shocks to the 2021 Kenya SAM reduces the estimated gross-output effects by approximately 10–11% and factor-value-added effects by approximately 6–7%, while labour-income effects are approximately 28% lower. The principal direction and sectoral pattern remain unchanged. Similarly, excluding the TSA residual categories Valuables and Other reduces the estimated gross-output effects but does not alter the main qualitative findings.

The findings have several implications for tourism and economic policy. First, domestic and regional tourism should be a permanent component of Kenya's resilience strategy rather than only temporary substitutes during international crises. The faster recovery of domestic tourism demonstrates its capacity to sustain part of the tourism

economy when international mobility is disrupted. Policies that improve domestic destination accessibility, affordability, information, transport connectivity, and product diversity can therefore broaden the tourism demand base.

Second, crisis-response policies should extend beyond businesses conventionally classified as tourism enterprises. The sizeable modelled effects on food processing, trade, livestock, crops, business services, and other activities demonstrate that tourism shocks propagate through supply chains. Support mechanisms during future crises should therefore consider tourism-linked suppliers, including small and medium-sized enterprises in agriculture, food production, transport, and services, rather than focusing exclusively on hotels, airlines, and tour operators.

Third, the findings highlight the importance of strengthening resilience in transport and connectivity. Transportation and storage recorded the largest modelled sectoral contraction. Kenya's dependence on international mobility means that disruptions in aviation and cross-border movement can rapidly affect accommodation, food services, attractions, and their suppliers. Diversifying visitor source markets, strengthening regional mobility, and improving domestic transport connectivity can reduce the concentration of this exposure.

Fourth, employment-support policies should recognise that the TSA employment benchmark includes both employees and self-employed workers. Crisis-response measures designed solely around payroll employment may therefore omit part of the tourism-directly supported workforce. Support mechanisms should be designed to reach both wage employees and self-employed workers in tourism-characteristic activities, while avoiding assumptions about the number of actual layoffs implied by the employment-equivalent estimates.

Fifth, economic diversification should be understood as complementing rather than displacing tourism. The results demonstrate substantial linkages among tourism, agriculture, food processing, transportation, trade, and business services. Strengthening these domestic linkages can simultaneously increase the local benefits generated by tourism during normal periods and improve the capacity of firms and households to withstand future demand shocks.

Finally, conservation-dependent destinations require more diversified financing mechanisms. Where protected areas and surrounding communities depend heavily on tourism revenues, sudden declines in visitor numbers can weaken conservation financing and local livelihoods. Public financing, conservation levies, partnerships, and alternative community income sources can reduce exclusive dependence on visitor expenditure.

The broader policy lesson is that tourism resilience requires a combination of market diversification, strong domestic and regional demand, resilient supply chains, inclusive worker protection, diversified conservation financing, and wider economic diversification. The objective is not to reduce tourism's contribution to the Kenyan economy, but to reduce the vulnerability created when that contribution depends heavily on a limited set of external-demand channels.

Limitations and future research directions

Several limitations should be considered when interpreting the results. First, the analysis uses a comparative-static SAM multiplier framework. Production coefficients, expenditure relationships, and prices are fixed, and the model does not endogenously represent supply constraints, price adjustments, substitution between inputs, capacity changes, firm closures, technological adaptation, or behavioural responses during the pandemic. The estimates, therefore, represent deterministic accounting-based effects conditional on the specified shocks and model structure rather than forecasts of realised economic outcomes (Breisinger et al., 2009).

Second, although the primary Kenya SAM is aligned to the 2019 macroeconomic benchmark, its detailed production structure draws substantially on the 2009 Kenya Supply and Use Table. This temporal difference may affect the magnitude of the estimated multipliers. To assess sensitivity to this temporal difference, the analysis is repeated using the 2021 Kenya SAM, which incorporates the more recent 2016 SUT. However, neither SAM fully represents the exceptional production, consumption, and behavioural adjustments that occurred during the pandemic (Thurlow, 2021; KIPPRA, KNBS, and IFPRI, 2023b).

Third, the quality of tourism demand shock construction varies across tourism products and visitor categories. Inbound tourism can be anchored to an observed annual series of monetary receipts, allowing the product-specific proxy rates to be calibrated to the aggregate monetary contraction. No equivalent comprehensive annual monetary

series for domestic tourism expenditure in 2020 and 2021 was identified in the reviewed official sources. Several domestic product shocks, therefore, rely on observable activity indicators such as resident hotel bed nights, transport passenger movements, and attraction visitation. These assumptions remain a source of modelling uncertainty and are documented in the Supplementary Information.

Fourth, the published TSA categories, Valuables and Other, do not provide sufficient product detail to uniquely map to individual SAM commodities. Their allocation in the primary specification therefore, requires an explicit modelling assumption. The residual-exclusion robustness test indicates that these categories affect the absolute magnitude of the estimates but do not alter the main direction or principal sectoral pattern.

Fifth, the employment analysis is limited to direct tourism employment-equivalent contractions. Indirect and induced employment headcounts are not estimated because the publicly available SAM records labour income rather than consistent physical employment counts across all activities. Furthermore, the employment calculation assumes fixed 2019 product-specific employment intensities and therefore does not capture changes in labour productivity, working hours, wages, unpaid leave, business survival, or informal-sector adjustment.

Sixth, the analysis does not directly quantify environmental, social, behavioural, or distributional consequences. Effects on conservation, community livelihoods, tourist confidence, firm adaptation, and household welfare are discussed only where supported by external literature. Although the Nexus SAM contains differentiated household accounts, a detailed distributional or poverty analysis falls outside the scope of the present study.

Future research could extend the analysis by integrating tourism shocks into dynamic computable general equilibrium models, thereby allowing prices, supply constraints, substitution, investment responses, and longer-term structural adjustments to be represented explicitly. More recent and tourism-specific Supply and Use or Input–Output structures would also improve the alignment between tourism expenditure and production technology. Future studies would additionally benefit from detailed annual monetary tourism expenditure data by product and visitor type, particularly for domestic tourism. Such data would reduce reliance on activity-based proxies and permit direct monetary validation of both inbound and domestic final-demand shocks. Further research could also combine the SAM framework with household microsimulation or distributional analysis to examine how tourism shocks affect different income groups, regions, genders, and informal workers. Mixed-methods research incorporating tourism enterprises, workers, communities, and conservation organisations could complement the monetary modelling by identifying adaptation strategies and social impacts that cannot be captured through fixed-coefficient accounting models.

Finally, applying a comparable TSA-SAM framework across other tourism-dependent African economies would help establish whether the Kenyan findings, particularly the faster recovery of domestic tourism, strong tourism-food-system linkages, and sensitivity of labour-income effects to economic structure, are also observed in other national contexts.

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Declarations

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