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RESEARCH ARTICLE

Tourism in Austria: biodiversity, environmental sustainability, and growth issues

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Abstract This study examined the long-run and causal relationships between international tourism, biodiversity loss, environmental sustainability, and specific growth factors under the premises of sustainable tourism in Austria, by using a consistent time series data from 1975 to 2015. The results reveal that inbound tourism, per capita income, and population density affected the potential habitat area while population density largely affected the food production in a country. Inbound tourism and population density both deteriorate the environmental quality in a form of increasing carbon dioxide (CO_2) emissions and fossil fuel energy consumption while per capita income reduces the fossil fuel energy consumption. Food exports increase per capita income, while food imports and population density both decrease economic growth. Inbound tourism and economic growth advance population density while forest area and food exports decrease the population density. The study supports growth-led tourism and growth-led food production in a country.

Keywords Inbound tourism · Biodiversity loss · Environmental sustainability · Per capita income · Bounds testing approach · Austria

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Introduction

International tourism played a pivotal role in order to develop and integrate economic and political factors to sustained broad-based economic growth; however, it has considerably affected the biodiversity and natural ecosystem conditions. Tourism has both a positive and negative binding forces with economic and environmental factors, as on the one side, it has provided economic opportunities to sustained livelihoods, while on the other side, it is a source of natural destruction (EU 2011). Sustainable tourism is one of the key desirable policy tools that efficiently raise economic opportunities, support livelihood programs, and simultaneously protect the biodiversity and ecological issues, by involving local communities to participate in awareness campaigns (UNEP 2005).

Austria is a landlocked country that covered around 83.870,9 km^2 and has a diversified landmass distribution including 10 % landmass that is occupied with alpine, 29 % of forest, 34 % distributed land to agriculture, and 40 % land devoted to permanent settlement areas. Austria has a high prolific biodiversity and ecosystem with around 45,000 different animal species including insects and vascular plants while having a high mountain ranging from Pannonian plains to high alpine regions, and from wetlands to forest areas (CBD 2015). Austria faced a severe biodiversity loss with multiple factors including rapid economic and industrial transformation for developing tourists' industry and resettlement of land for transport and tourist infrastructure.

The relationships between international tourism, biodiversity loss, environmental sustainability, and growth issues are the concurrent part of the sustainability policy agenda, which previously addressed in number of parallel studies; however, this study is distinctive in a sense that it has incorporated more diversified proxies to evaluate the impact of international tourism (i.e., international tourists' arrival) on forest biodiversity loss (by taking three foremost indicators including forest area that represent potential habitat area, food exports, and food imports), environmental sustainability (referred by CO_2 emissions and fossil fuel energy consumption), and specific growth factors (i.e., GDP per capita and population density); all these factors are significantly influenced by massive international tourists' arrival in Austria.

The environmental impacts of tourism provide a basis for justifying nature conservation by integrated economic policies for sustainable tourism. Sustainable tourism more convincingly included on the policy agenda since the 1990s. Pigram (1990) highlighted the importance of sustainable tourism—as a viable tool for economic development and environmental prosperity, which further emphasized the continual environmental education of different stakeholders for nature conservation. Lane (1994) discussed different strategies for promoting rural tourism that flared with sustainability elements and argued that sustainable tourism is a desirable policy tool for rural development support and resource conservation. Lukashina et al. (1996) identified different factors that affect the natural environment of Sochi, Russia, including expansion of tourism resorts, fuel consumption, travel and transport services, and tourist's enterprises; all factors harms the scenic beauty of Sochi, Russia. The policies should be made by including legal measures to conserve environment. Milne et al. (1998) argued that sustainable tourism is the attractive strategy for promoting economic development; however, it is hardly achieved due to certain local and global socio-economic-cultural factors; therefore, it is necessary to formulate a conjunctive theoretical framework that linked with national and international collaboration to speed up the pace of economic development through mutual tourism. Sharpley (2000) argued that sustainable tourism and sustainable development are the two sides of the same coin that stand aside while devising sustainable policies for long-term economic growth. Neto (2002) argued that international tourism development on the basis of sustainability policy agenda required eco-friendly investment that would be helpful to reduce environmental issues and deliver greater benefits of sustainable tourism. Van der Duim and Caalders (2002) examined the impact of international tourism on biodiversity and provoked the need to preserve global biodiversity as per "United Nations convention on biological diversity" for environmental sustainability. Liu (2003) critically evaluated the sustainable tourism framework and identified some potential factors that expedite the process of sustainability for broad-based economic growth including socio-cultural development progress and resource conservation. Bianchi (2004) highlighted the need of tourism restructuring as per sustainable node and argued that political disclosures, political power, and ideologies would be helpful to reshape the sustainable tourism agenda for pro-equality growth reforms at nationwide. Mbaiwa (2005) described the positive and negative outcomes of tourism demand in socio-cultural aspects, i.e., international tourism development triggered the economic growth and employment opportunities through tourism infrastructure development, while it escalates the crime rates, prostitution, western dressing, "vulgar" language, racism, etc. The enviable condition for sustained tourism is to promote socio-cultural aspects and mitigate the negative cultural impacts, while it further promotes the positivity of cultural tourism to preserve cultural identity. Becken and Patterson (2006) discussed the importance of international tourism in national income accounting and measured national scale carbon emissions from international tourism and argued that international tourism utilized energy directly from fossil fuel energy consumption, which is considered to be the potential detrimental factor to restrain the sustainable policy agenda.

Schloegel (2007) argued in a favor of sustainable tourism to promote biological diversity, while Hunter and Shaw (2007) considered "ecological footprint" as a potential predictor of sustainable tourism and concluded that ecotourism products have a positive role in order to conserve natural resources at global scale. The policies for sustainable tourism growth required effective environmental policy intervention to assess ecological footprints due to tourism demand. Lee et al. (2009) revealed that international tourism demand has a considerable impact on environmental quality index, i.e., water and air quality index; therefore, the policies should be made in a way to mitigate air and water pollution through sustainable tourism instruments. Buckley (2012) suggested different key drivers that improve the sustainability of tourism sector including regulatory measures, market measures, and political measures; however, regulatory measures have a distinct place of uniqueness in promoting sustainable tourism globally. Lee and Brahmasrene (2013) revealed that international tourism and FDI inflows spur economic growth, while both have a negative impact on CO_2 emissions. Economic growth significantly associated with the increase carbon emissions across the countries. Paci and Marrocu (2014) confirmed that regional growth has a strong and potential impact on international and domestic tourism. Farmaki et al. (2015) examined the impact of political measures on implementation of sustainable tourism in Cyprus and revealed that political measures inhibit the proper implementation of sustainable tourism in a country due to external axes of power. The socio-cultural environment on the politics is the strong predictor that restrains the policies of sustainable tourism. Joseph (2015) investigated the relationship between international tourism and biodiversity loss in the South-Western coastline in Sri Lanka and found that tourism activities have a negative influencing impact on coastal species, which destroy the coastal environment and habitat that need effective conservation policies to preserve potential habitat area. Ozturk et al. (2016) investigated the long-run relationship between ecological footprint and tourism growth under the domain of environmental Kuznets curve (EKC) hypothesis in a diversified panel of countries and found that there is a negative relationship between ecological footprint and tourism growth in high-income and upper-middle income countries, while EKC hypothesis is supported in both the income regions.

Tang and Tan (2015) investigated the causal relationship between international tourism and Malaysian economic growth and validate the “tourism-led growth” hypothesis in a country. Tang and Abosedra (2015) confirmed the tourism-led growth hypothesis in a context of Lebanon while real exchange rates Granger cause economic growth and international tourism in a country. The results are in favor to promote tourism by stable real exchange rate for long-term economic development. Tang et al. (2016) investigated the long-run and causal relationship between international tourism, energy demand, and economic growth and supported the tourism-led growth hypothesis in India under the presence of energy demand. The results provoked in favor of tourism and renewable energy sources for economic transformation and development. Zhang and Gao (2016) examined the interrelationships between international tourism, energy demand, CO_2 emissions, and China’s economic growth and found that international tourism has a negative effect on carbon emissions while tourism-induced environmental Kuznets curve is weakly supported in western and eastern China. The study concludes with the support of low-carbon tourism in a region. Shahbaz et al. (2016) confirmed the feedback hypothesis between tourism indicators and economic growth, between tourism and financial development, and between tourism and trade openness in the case of Malaysia. The results argued that tourism indicators are well connected with the economic factors; therefore, the policies for promoting international tourism automatically enhanced the capacity of country’s economic growth. Ozturk (2016) found that health expenditures significantly improve the international tourism indicators while energy demand decreases the tourism growth. CO_2 emissions, however, have a positive association with the international tourism in a panel of developing and developed countries, which required low-carbon tourism policies and efficient renewable energy sources for augmenting regional growth. Luo et al. (2016) highlighted the importance of urbanization in tourism management practices and concluded that the impact of urbanization on international tourism is distinct in different regions; therefore, the policies should be formulated with caution and with care while handling urbanization in tourism policy agenda. Zaman et al. (2016a) argued that international tourism has a detrimental impact on environmental degradation, as it considerably increases energy consumption and carbon emissions, which required strong policy measures to device eco-tourism policies across the world regions. Zaman et al. (2016b) further provoked that international tourism increases per capita income on the cost of environmental degradation; therefore, policies should be strongly advocated for sustainable tourism to reduce the environmental concern of tourism and intensified eco-friendly growth policies for sustainable development.

The enviable form of planet happiness is the promotion of sustainable tourism and preservation of natural resources for long-term sustainability in the biological process. The channel through which forest biodiversity is affected by massive internationalization of tourism, environmental considerations, population density, and per capita income that further linked with the food security challenges in a country. Figure 1 shows the theoretical underpinning of interlinkages between international tourism and biodiversity for ready reference.

Milder et al. (2016) concluded that promotion of tourism development without knowing its impact on biological diversity is the major concern area in the sustainable tourism.

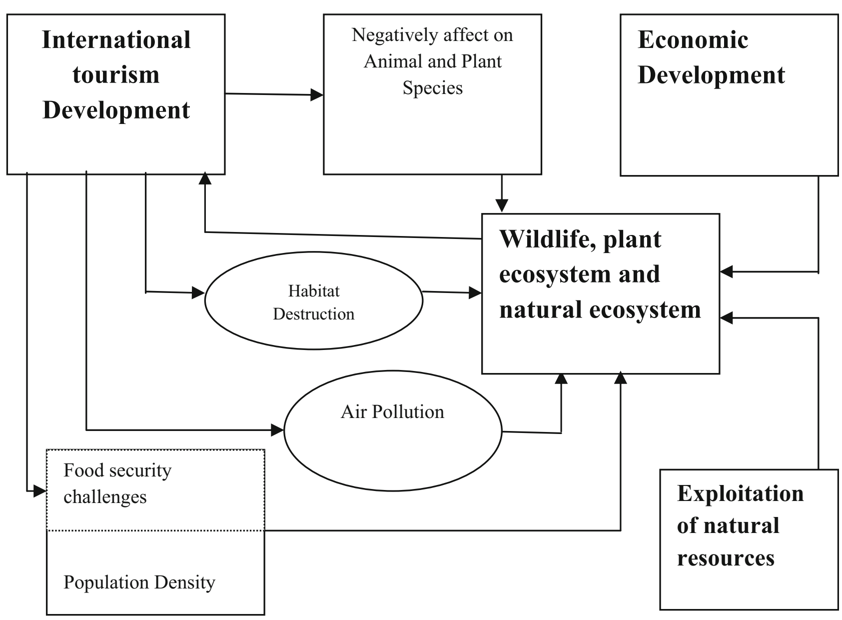

Fig. 1 International tourism and Biodiversity Nexus. Source: Adapted from Milder et al. (2016)

International tourism affected different animal and plant species, and ecosystem through destruction of forest area, environmental pollution, and under utilization of natural resources. The study emphasized the need of sustainability in the practices of tourism standards and practices for conservation of natural resources across the globe. The above discussion confirms the strong relationship between international tourism, biodiversity loss, environmental sustainability, and growth factors across the globe. This study examined the long-run and causal relationship between international tourist's arrival, forest biodiversity loss, environmental degradation, and specific growth factors in the context of Austria. These objectives are achieved by time series cointegration and causal techniques in a given country context. The study designated the set of policy instruments to promote sustainable tourism across the globe.

Data source and methodology

The study collected the data of biodiversity, environmental sustainability, growth factors, and international tourism from World Development Indicators published by World Bank (2016). Forest biodiversity comprises forest area (% of land area), food exports (% of merchandise exports), and food imports (% of merchandise imports); environmental sustainability includes CO_2 emissions (metric tons per capita) and fossil fuel energy consumption (% of total); growth factors are GDP per capita (constant 2005 US$) and population density (people per square km of land area); and tourism indicator represents with international tourism arrivals in numbers. Biodiversity, environmental sustainability, and growth factors served as a "response" variable of the study while inbound tourism (and growth factors, in the majority of the cases) served as "explanatory" variables of the study. The studied variables have some missing data between the two different time periods; therefore, the study filled with the forward and backward interpolation technique is required. These variables are selected because of the two main reasons; first, Austrian tourism has a unique standing in terms of receiving number of international tourists all across from the globe; second, the country faces severe environmental concerns including biodiversity loss and environmental degradation due to tourists' ecological footprints, which need to be conserved according to the United Nations—Kyoto protocol.

The study extended the Solow growth model (Solow 1955) by incorporating environmental variables in a growth model, i.e.,

$$Y_t = f\left(K^{\alpha}{}_t, AL^{\beta}{}_t, F^{\varphi}{}_t, E^{\theta}{}_t, M^{\nu}{}_t\right) \tag{1}$$

where "Y" is the dependent variable, "K" is the capital stock, "AL" is the labor augmenting, "F" is the forest area, "E" is the food export, and "M" is the food import.

Equation (1) is decomposed by log-log specification to estimate an elasticity, i.e.,

$$\ln Y_t = \alpha \ln K_t + \beta(\ln A + \ln L_t) + \varphi \ln F_t + \theta \ln E_t + \nu \ln M_t + \varepsilon_t \tag{2}$$

Equation (2) shows that output is the function of capital stock, effective labor, forest area, food exports, and food imports.

By using Eq. (2), we made a number of simultaneous equations to evaluate the long-run relationship between inbound tourism, biodiversity, environmental sustainability, and growth factors in a given country, i.e.,

Model 1: Biodiversity and inbound tourism

$$\ln(\text{BIODIV})_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_t + \Gamma_2 \ln(\text{GDPPC})_t + \Gamma_3 \ln(\text{POPDEN})_t + \varepsilon_t \tag{3}$$

Model 11: Environmental sustainability and inbound tourism

$$\ln(\text{ESUST})_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_t + \Gamma_2 \ln(\text{GDPPC})_t + \Gamma_3 \ln(\text{POPDEN})_t + \varepsilon_t \tag{4}$$

Model 111: Growth factors and inbound tourism

$$\ln(GRW)_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_t + \Gamma_2 \ln(\text{POPDEN})_t + \Gamma_3 \ln(\text{FAREA})_t + \Gamma_4 \ln(\text{FEXP})_t + \Gamma_5 \ln(\text{FIMP})_t + \varepsilon_t \tag{5}$$

where BIODIV indicates biodiversity that includes forest area, food exports, and food imports; ESUST indicates environmental sustainability that is proxied by CO_2 emissions and fossil fuel energy consumption; GRW indicates growth specific factors that includes per capita GDP and population density; INBOUND indicates international tourist arrival, FAREA indicates forest area, FEXP indicates food exports, FIMP indicates food imports, "ln" indicates natural logarithm, "t" indicates time period from 1975 to 2015, and ε indicates error term.

Austria is the rich species country of Central Europe that has a great potential of biodiversity due to its topographic conditions, which is prominent from the rest of the European countries. Austria's biological diversity strategy 2020+ helpful to enhance the quality of life of animal and plant species that transformed in to country's sustainability and environmental reforms for country's future (Deweis 2014). Tourism development is the most significant predictor that influences biodiversity while reaping economic benefits over the environmental degradation. Austria is no exception, as massive internationalization of tourism reforms exhausts the biodiversity that required strong policy vista for broad-based growth.

Breakpoint unit root test

The study employed time series cointegration technique to examine the long-run and causal relationship between biodiversity, environmental sustainability, growth factors, and inbound tourism in a context of Pakistan by using a consistent data series from 1975 to 2015. The study started with the unit root test by Augment Dickey-Fuller (ADF) to assess the stationarity series of the studied variables. There are number of unit root tests available in time series domain including ADF unit root test, Phillips-Perron unit root test, Kwiatkowski-Phillips-Schmidt-Shin unit root test, Ng-Perron unit root test, etc.; however, breakpoint unit root test has a unique standing in the time series technique that offered different breakpoint selection criteria including minimize Dickey-Fuller t-statistic, minimize intercept break t-statistic, maximize intercept break t-statistic, etc., with break type innovation outlier. These unique breakpoint unit root tests not only assess the stationarity series in the individual candidate variable but also offer the unique breakpoint date that indicates the structural break due to adjustment process in the economy. In this study, we used breakpoint unit root test to assess the stationarity series in the given variables' series under the "innovational outlier tests," i.e.,

$$y_t = y_{t-1} + \alpha + \psi(L)(\theta D_t(T_b) + \beta DU_t(T_b) + \varepsilon_t) \tag{i}$$

where ε_t is 'i.i.d innovations and $\psi(L)$ is the invertible process of autoregressive moving average process (ARMA) errors that are representing the stationary dynamics in a lag polynomial function. The study follows a trend stationary model with structural breaks in the constant and trend, i.e.,

$$y_t = \mu + \alpha_t + \psi(L)(\theta DU_t(T_b) + \beta DT_t(T_b) + \varepsilon_t) \tag{ii}$$

The Dickey Fuller specifications allowed different assumptions for the time trend and structural break process including the following:

- Model 0: Constant break with non-specific data trending, i.e., in Eqs. (i) and (ii), the value of α and β set equal to zero yields a non-stationary process against the intercept break stationary model, i.e.,

$$y_t = \mu + \theta DU_t(T_b) + \omega D_t(T_b) + \gamma y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{iii}$$

- Model 1: Constant break with trending data, where the β value in Eqs. (i) and (ii) set equal to zero produces a test of non-stationary with time trend in constant break, i.e.,

$$y_t = \mu + \alpha_t + \theta DU_t(T_b) + \omega D_t(T_b) + \gamma y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{iv}$$

- Model 2: Constant and trend break data used to evaluate the non-stationary process with drift against the trend stationary with constant and alternative trend break, i.e.,

$$y_t = \mu + \alpha_t + \theta DU_t(T_b) + \beta DT_t(T_B) + \omega D_t(T_b) + \gamma y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{v}$$

- Model 3: Trending data with trend break point used to set out constant break and break dummy coefficients, i.e., θ and ω, consider equal to zero for testing the random walk hypothesis with trend against a trend stationary with trend break alternative, i.e.,

$$y_t = \mu + \alpha_t + \beta DT_t(T_b) + \gamma y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + u_t \tag{vi}$$

The further understanding for the breakpoint unit root tests extracted from the methodology of Zivot and Andrews (2002), Banerjee et al. (1992), Vogelsang and Perron (1998), Perron (1989), and Kim and Perron (2009).

Autoregressive distributed lags model (bounds testing approach)

The study further employed AutoRegressive Distributed Lags (ARDL) Model for time series cointegration analysis. ARDL model is mostly used in time series analysis where the order of integration of the studied variables are mixed, i.e., dependent variable would be order of integration one, I(1), while the explanatory variables either have an order of integration zero, I(0) or I(1), or both. The ARDL model specification is further used where the sample size is relatively small, and Johansen cointegration could not be provided efficient estimates due to faced severe problem of degree of freedom.

The term "autoregressive" shows lagged dependent variable, while "distributed lags" show lagged explanatory variables; therefore, mostly denoted "ARDL" with the notation, i.e., ARDL(p, q_1, q_2, ….q_k), where "p" is the number of lags of the "response" variable, "q_1" shows the number of lags of the first independent variable, "q_2" shows the number of lags of the second independent variable, and "q_k" represents the number of lags of the k-th independent variable.

An ARDL (p, q_1, q_2, ….q_k) model has a following specification, i.e.,

$$y_t = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_i} X_{j,t-i}\beta_{j,i} + \varepsilon_i \qquad \text{(vii)}$$

where "y" is the dependent variable followed with the lagged dependent variable, i.e., "y_{t-1}", X_j is the set of explanatory variables which may and may not have lagged terms in the model ($q_j = 0$). Explanatory variables which have no lagged term are called "fixed or static" regressors, while the explanatory variables having at least one lagged term are called "dynamic" regressors. The criteria for lagged term selection mostly based on the following information criteria including standard Schwarz information criteria (SIC), Akaike information criteria (AIC), Hannan-Quinn information criteria (QIC), etc. In this study, we used SIC for lagged length selection.

Long-run and cointegration analysis

The ARDL model estimated dynamic relationship between "response" variable and "regressors,"; therefore, to transform into the long-run relationship, we required the more generic form of equations. Conventionally, there are a number of cointegration techniques available to assess the dynamic relationship between the variables including Johansen's cointegration, Engle-Granger cointegration, dynamic OLS, fully modified OLS, etc. Pesaran and Shin (1999) developed a new form of cointegration that can be estimated through ARDL model. This model has a distinct edge on to the other available conventional cointegration techniques, that is, it includes both the I(0) and I(1) variables without requiring any prior knowledge for variables' order of integration. The ARDL cointegration form can be obtained through the following equation, i.e.,

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-1}\beta_{j,i^*} - \varphi EC_{t-1} + \varepsilon_t \qquad \text{(viii)}$$

where EC_{t-1} shows error correction term that trace out the speed of adjustment of the model toward the equilibrium.

Bounds testing

By using the Eq. (8), we may assess that whether the relationship between the variables in the ARDL model contains a long-run relationship, or otherwise, for this assessment, the bounds testing procedure is used in the following schematic fashion, i.e.,

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-1}\beta_{j,i^*} - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}\delta_j + \varepsilon_t \qquad \text{(ix)}$$

The test for the long-run relationship is found from a regression using Eq. (9), i.e.,

$$\rho = 0$$
$$\delta_1 = \delta_2 = ... = \delta_k = 0$$

Pesaran et al. (2001) provide different critical values for regressors I(0) and I(1) and suggested these values as a reference bounds for the more special cases where the regressors are a mixture of I(0) and I(1).

The study follows the Pesaran et al. (2001) model specification and formulated the vector autoregression (VAR) of order p, denoted VAR (p), for the following function, i.e.,

$$Z_t = \mu + \sum_{i=1}^{p} \beta_i z_{t-i} + \varepsilon_t \qquad \text{(x)}$$

where z_t is the vector of both dependent and independent variables of the study, which is shown in Eq. (1) to Eq. (7).

The study further developed a vector error correction model (VECM) in the prescribed set of studied variables that are as follows:

$$\Delta z_t = \mu + \alpha t + \lambda z_{t-1} + \sum_{i=1}^{p-i} \gamma_t \Delta y_{t-i} + \sum_{i=1}^{p-1} \gamma_t \Delta x_{t-i} + \varepsilon_t \quad \text{(xi)}$$

where Δ is the first-difference operator. The long-run multiplier matrix λ is as follows:

$$\lambda = \begin{bmatrix} \lambda_{YY} \lambda_{YX} \\ \lambda_{XY} \lambda_{XX} \end{bmatrix}$$

The diagonal elements show the unrestricted matrix; therefore, the variable series either hold a random walk or trend stationary, i.e., If $\lambda_{YY}=0$, then "Y" is the order of integration one, I(1), while, if $\lambda_{YY}<0$, then "Y" is the order of integration zero, I(0). The study utilized the case III of Pesaran et al. (2001) that is unrestricted constant and no linear trend, while after imposing the restriction, i.e., $\lambda_{YY}=0$, $\mu \neq 0$ and $\alpha=0$, the following unrestricted error correction model (UECM) equations are as follows, i.e.,

$$\Delta \ln(\text{BIODIV})_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_{t-1} + \Gamma_2 \ln(\text{GDPPC})_{t-1} + \Gamma_3 \ln(\text{POPDEN})_{t-1} + \sum_{i=1}^{p} \Delta \ln(\text{BIODIV})_{t-1} + \sum_{i=1}^{q} \Delta \ln(\text{INBOUND})_{t-1} + \sum_{i=1}^{R} \Delta \ln(\text{GDPPC})_{t-1} + \varepsilon_t \quad (1.1)$$

$$\Delta \ln(\text{ESUST})_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_{t-1} + \Gamma_2 \ln(\text{GDPPC})_{t-1} + \Gamma_3 \ln(\text{POPDEN})_{t-1} + \sum_{i=1}^{p} \Delta \ln(\text{ESUST})_{t-1} + \sum_{i=1}^{q} \Delta \ln(\text{INBOUND})_{t-1} + \sum_{i=1}^{R} \Delta \ln(\text{GDPPC})_{t-1} + \varepsilon_t \quad (2.1)$$

$$\Delta \ln(GRW)_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_{t-1} + \Gamma_2 \ln(\text{POPDEN})_{t-1} + \Gamma_3 \ln(\text{FAREA})_{t-1} + \Gamma_4 \ln(\text{FEXP})_{t-1} + \Gamma_5 \ln(\text{FIMP})_{t-1} + \sum_{i=1}^{p} \Delta \ln(GRW)_{t-1} + \sum_{i=1}^{q} \Delta \ln(\text{INBOUND})_{t-1} + \sum_{i=1}^{R} \Delta \ln(\text{POPDEN})_{t-1} + \sum_{i=1}^{S} \Delta \ln(\text{FAREA})_{t-1} + \sum_{i=1}^{T} \Delta \ln(\text{FEXP})_{t-1} + \sum_{i=1}^{U} \Delta \ln(\text{FIMP})_{t-1} + \varepsilon_t \quad (3.1)$$

where Δ is the first-difference operator and ε_t is a white-noise disturbance term. Equation (1.1) to Eq. (3.1) indicate the dependent variables influenced by its past values; therefore, it is included in the ARDL model specification. The Wald test is used to perform restrictions on the estimated long-run studied coefficients to establish the long-run relationship that exists between the variables. Finally, the error correction term is included to identify the speed of adjustment of the model toward the equilibrium; therefore, the residual which is obtained from regression apparatus included in the above equations from Eq. (1.1) to Eq. (3.1) with first lagged operator, i.e.,

$$\Delta \ln(\text{BIODIV})_t = \Gamma_0 + \Gamma_1 \ln(\text{INBOUND})_{t-1} + \Gamma_2 \ln(\text{GDPPC})_{t-1} + \Gamma_3 \ln(\text{POPDEN})_{t-1} + \sum_{i=1}^{p} \Delta \ln(\text{BIODIV})_{t-1} + \sum_{i=1}^{q} \Delta \ln(\text{INBOUND})_{t-1} + \sum_{i=1}^{R} \Delta \ln(\text{GDPPC})_{t-1} + k(ECT_{t-1}) + \varepsilon_t \quad (1.1.1)$$

$$\Delta\ln(\mathrm{ESUST})_t = \Gamma_0 + \Gamma_1\ln(\mathrm{INBOUND})_{t-1} + \Gamma_2\ln(\mathrm{GDPPC})_{t-1} + \Gamma_3\ln(\mathrm{POPDEN})_{t-1} + \sum_{i=1}^{p}\Delta\ln(\mathrm{ESUST})_{t-1} + \sum_{i=1}^{q}\Delta\ln(\mathrm{INBOUND})_{t-1} + \sum_{i=1}^{R}\Delta\ln(\mathrm{GDPPC})_{t-1} + k(ECT_{t-1}) + \varepsilon_t \quad (2.1.1)$$

$$\Delta\ln(GRW)_t = \Gamma_0 + \Gamma_1\ln(\mathrm{INBOUND})_{t-1} + \Gamma_2\ln(\mathrm{POPDEN})_{t-1} + \Gamma_3\ln(\mathrm{FAREA})_{t-1} + \Gamma_4\ln(\mathrm{FEXP})_{t-1} + \Gamma_5\ln(\mathrm{FIMP})_{t-1} + \sum_{i=1}^{p}\Delta\ln(GRW)_{t-1} + \sum_{i=1}^{q}\Delta\ln(\mathrm{INBOUND})_{t-1} + \sum_{i=1}^{R}\Delta\ln(\mathrm{POPDEN})_{t-1} + \sum_{i=1}^{S}\Delta\ln(\mathrm{FAREA})_{t-1} + \sum_{i=1}^{T}\Delta\ln(\mathrm{FEXP})_{t-1} + \sum_{i=1}^{U}\Delta\ln(\mathrm{FIMP})_{t-1} + k(ECT_{t-1}) + \varepsilon_t \quad (3.1.1)$$

where “k” is the coefficient of error correction term (ECT) that is expected to have a negative coefficient value for analyzing the speed of adjustment of the model toward equilibrium.

Results

Table 1 shows the descriptive statistics of the variables for ready reference. The statistics show that all the variables having a positive mean value and considerable peak of the distribution, which implies that along with an increase in international inbound tourism, there is an enormous increase in growth specific factors, environmental pollutants, and biodiversity loss during the study time period.

Table 1 further shows the estimates of correlation matrix, and the results show that CO_2 emissions have a positive and significant correlation with forest area (i.e., $r = 0.478$, $p < 0.01$), food exports ($r = 0.584$, $p < 0.01$), GDP per capita ($r = 0.681$, $p < 0.01$), inbound tourism ($r = 0.504$, $p < 0.01$), and population density ($r = 0.656$, $p < 0.01$), while it has a negative correlation with the fossil fuel energy consumption ($r = -0.355$, $p < 0.05$). On the other hand, GDP per capita has a significant and positive correlation with the forest area ($r = 0.872$, $p < 0.01$), food exports ($r = 0.822$, $p < 0.01$), international tourists’ arrival ($r = 0.868$, $p < 0.01$), and

Table 1 Descriptive statistics and correlation matrix

	CO2	FAREA	FEXP	FFUEL	FIMP	GDPPC	INBOUND	POPDEN
Mean	7.755	45.273	4.993	77.628	6.504	31,823.210	18,432,244	96.043
Maximum	9.028	46.998	7.546	89.600	8.240	41,229.730	26,122,000	103.676
Minimum	6.874	40.124	3.255	63.435	5.109	20,049.810	15,010,000	91.420
Std. Dev.	0.554	1.906	1.343	6.380	0.885	6962.805	2,970,433	4.103
Skewness	0.460	−1.392	0.566	−0.203	0.373	−0.046	1.181	0.319
Kurtosis	2.542	3.864	2.014	2.753	2.129	1.595	3.336	1.735
Correlation matrix								
CO2	1							
FAREA	0.478*	1						
FEXP	0.584*	0.529*	1					
FFUEL	−0.355**	−0.842*	−0.744*	1				
FIMP	0.023	-0.382**	0.510*	−0.057	1			
GDPPC	0.681*	0.872*	0.822*	−0.887*	0.009	1		
INBOUND	0.504*	0.655*	0.901*	−0.906*	0.348**	0.868*	1	
POPDEN	0.656*	0.761*	0.882*	−0.873*	0.205	0.965*	0.921*	1

Note: CO2 indicates CO_2 emissions, FAREA indicates forest area, FEXP indicates food exports, FFUEL indicates fossil fuel energy consumption, FIMP indicates food imports, GDPPC indicates GDP per capita, INBOUND indicates inbound tourism, and POPDEN indicates population density. Small bracket shows probability values. * and ** indicate 1 and 5 % level of significance

Table 2 Estimates of unit root test with break test

Variables	Level (break year)		First difference (break year)	
	Intercept	Intercept and trend	Intercept	Intercept and trend
INBOUND	0.877 (2004)	−0.664 (2010)	−8.598* (1997)	−8.561* (1997)
CO2	−4.040 (1994)	−3.948 (1995)	−9.613* (2009)	−9.911* (2005)
FFUEL	−2.140 (2005)	−2.655 (1993)	−6.753* (1990)	−8.127* (1988)
GDPPC	−2.553 (1994)	−3.152 (2012)	−7.200* (2009)	−7.283* (2009)
POPDEN	−1.703 (1988)	−2.849 (2000)	−4.682** (1988)	−4.729** (1988)
FAREA	−6.219* (2014)	−15.319* (1988)	−7.389* (1990)	−6.234* (1991)
FEXP	−1.979 (1995)	−2.320 (1987)	−7.947* (1992)	−8.115* (2009)
FIMP	−3.204 (2006)	−2.787 (2007)	−6.050* (2000)	−6.727* (2009)

Note: Small bracket shows probability values. *and ** indicate 1 and 5 % level of significance

population density ($r = 0.965$, $p < 0.01$), while it has a negative correlation with the fossil fuel energy consumption ($r = -0.887$, $p < 0.01$).

There is a significant and positive correlation between inbound tourism and CO_2 emissions (0.504, $p < 0.01$), forest area ($r = 0.655$, $p < 0.01$), food exports ($r = 0.901$, $p < 0.01$), food imports ($r = 0.868$, $p < 0.05$), and population density ($r = 0.921$, $p < 0.01$), while it has a negative correlation with fossil fuel energy consumption ($r = -0.906$, $p < 0.01$). Finally, population density significantly increases CO_2 emissions, forest area, food exports, inbound tourism, and GDP per capita, while it significantly decreases fossil fuel energy consumption countrywide. After presenting the descriptive statistics and correlation matrix, the study further moves toward the individual unit root process to assess the stationarity series of the variables with certain breakpoint dates and presented the results in Table 2.

The results of breakpoint unit root test show that inbound tourism exhibit a non-stationary series at the level while it becomes stationary at first difference. At level test, we found two structural break date, i.e., at level with "intercept," the break year was 2004, while at level with "intercept and trend," the break year was 2010. On the other hand, after decomposition of inbound tourism with a first difference, the break year was 1997. One thing to observe from the inbound tourism data is that there are three critical years in the given data set that is considered as an innovative outlier, which reflects that the structural adjustment takes place in order to attract the customers by sophisticated economic reforms, i.e., per capita income significantly increases along with decrease carbon emissions and fossil fuel energy consumption; however, the proportion of food imports were larger than the food exports during these years, which shows food deficit in a country by massive inbound tourism in a country. Next, the data series of CO_2 emissions exhibit the difference stationary with four innovative outliers, i.e., 1994 (at level—constant), 1995 (at level—constant and trend), 2005 (at first difference—constant and trend), and 2009 (at first difference—constant and trend). These break dates indicate that CO_2 emissions considerably increase from 1994 to 2005, which substantially decreases from 2005 to 2009, and later on, the trend of carbon emissions are moving around an average. The variations have been visible in the data of food imports and exports that tend to wrap with food deficit. The data of fossil fuel energy consumption increases with decreasing rate while per capita GDP increases along with the increase international tourist's arrival in a country. The data set of fossil fuel energy consumption, GDP per capita, population density, food exports, and food imports all exhibits the non-stationary trend at the level while it becomes stationary at first difference. The data series of the variable, i.e., forest area, exhibit stationary at level with four distinct structural dates, i.e., 1990, 1991, 1998, and 2014. These structural breaks confirm the innovative outliers that indicate some conclusive structural adjustments in the economy particularly to international tourism, biodiversity loss, environmental sustainability, and growth issues in a country. The overall results of unit root with break test indicate that except forest area, all remaining candidate variables exhibit non-stationary at the level, while it becomes stationary at first difference; therefore, the order of integration for all these variables is one, I(1). The data series of forest area exhibit level stationary; therefore, the order of integration is zero, I(0). The mixture of the order of integration between the studied variables provides a good logical consideration to employed autoregressive distributed lag (ARDL) model, sometimes called bounds testing approach to assessing the long-run and cointegration relationship between the variables. Table 3 shows the ARDL estimate of cointegration between the variables.

The results of ARDL cointegration test with four explanatory variables fairly satisfied the alternative hypothesis of cointegration relationship between the variables. The value of Wald F-statistics for CO_2 emissions is about 3.879, which is significant at 1 % level as per I(0) lower bound while it is significant at 10 % level as per I(1) bound. The remaining variables including fossil fuel energy consumption, population density, per capita GDP, and inbound tourism all confirm the cointegration relationship between the variables that fall in the I(1) upper bound critical value, i.e., the value of Wald F-

Table 3 The results of autoregressive distributed lag cointegration test

Models	Lag length	Structural break	Wald-statistics
$CO2_t = f(INBOUND_t, FFUEL_t, POPDEN_t, GDPPC_t)$	4,2,0,0,4	1994	3.879
$FFUEL_t = f(CO2_t, INBOUND_t, POPDEN_t, GDPPC_t)$	4,0,4,2,3	2005	4.573
$POPDEN_t = f(CO2_t, FFUEL_t, INBOUND_t, GDPPC_t)$	2,4,4,3,2	1988	9.660
$GDPPC_t = f(CO2_t, FFUEL_t, POPDEN_t, INBOUND_t)$	4,4,4,4,4	1994	7.071
$INBOUND_t = f(CO2_t, FFUEL_t, POPDEN_t, GDPPC_t)$	4,2,2,4,2	2004	6.600
$CO2_t = f(INBOUND_t, GDPPC_t, FAREA_t, FEXP_t, FIMP_t)$	2,4,4,4,0,4	1994	3.701
$GDPPC_t = f(CO2_t, INBOUND_t, FAREA_t, FEXP_t, FIMP_t)$	3,4,4,4,3,4	1994	2.735
$FAREA_t = f(CO2_t, GDPPC_t, INBOUND_t, FEXP_t, FIMP_t)$	4,4,4,4,3,4	2014	23.542
$FEXP_t = f(CO2_t, GDPPC_t, FAREA_t, INBOUND_t, FIMP_t)$	1,2,4,4,4,0	1995	3.343
$FIMP_t = f(CO2_t, GDPPC_t, FAREA_t, FEXP_t, INBOUND_t)$	1,2,4,4,1,4	2006	7.467
$INBOUND_t = f(CO2_t, GDPPC_t, FAREA_t, FEXP_t, FIMP_t)$	4,4,4,4,2,3	2004	7.384
Critical value bounds			
Significance		I(0) Bound	I(1) Bound
10 %		2.45	3.52
5 %		2.86	4.01
2.5 %		3.25	4.49
1 %		3.74	5.06

Note: CO2 indicates CO_2 emissions, FAREA indicates forest area, FEXP indicates food exports, FFUEL indicates fossil fuel energy consumption, FIMP indicates food imports, GDPPC indicates GDP per capita, INBOUND indicates inbound tourism, and POPDEN indicates population density

statistics of fossil fuel fall in I(1) upper bound critical value which is about 4.573, $p < 0.05$; population density fall in the I(1) upper bound critical value that is about 9.660, $p < 0.000$; per capita income statistic is about 7.071, $p < 0.000$; and inbound tourism is about 6.600, $p < 0.000$. These statistics are helpful to determine the existence of long-run relationship between the candidate variables. The lag length of the respective equations indicates the long-run convergence toward the equilibrium in the given model, as CO2 emissions, fossil fuel energy, per capita income, and inbound tourism contained 4-lagged transformation, while population density indicates the 2-lagged transformation period. The structural break period is identified for CO2 emissions that were in the year 1994, where rapid economic growth considerably increases carbon emissions in a region. The structural break for fossil fuel, population density, per capita income, and inbound tourism was in the year 2005, 1988, 1994, and 2004, respectively. These were the periods where rapid economic transformation was on pace that leads to increase fossil fuel, population density, per capita income, and inbound tourism, which need strong policy vista for sustainable development in a region.

The results of ARDL cointegration test with five explanatory variables confirmed that the selected variables have a long-run and cointegration relationship between them, as GDP per capita and food exports statistics fall in the I(0) lower bound critical value at 5 %, while remaining models including CO_2 emissions, forest area, food imports, and inbound tourism fall in the I(1) upper bound critical value. The structural break period for CO2 emissions, per capita income, forest area, food exports, food imports, and inbound tourism was identified for the period of 1994, 1994, 2014, 1995, 2006, and 2004, respectively. The results clearly exhibit the long-run and cointegration relationship between the variables, which further required to estimate the short-run and long-run parameters for conclusive finding. Table 4 shows the short-run and long-run parameter estimates for robust inferences.

The results of short-run elasticity show that inbound tourism has a significant and negative relationship with forest area, while per capita income and population density both have a significant and positive relationship with forest area. The forest area here used as a proxy for forest biodiversity, which shows that expansion in the international tourism industry leads to deteriorate forest biodiversity that substantially rewarded per capita income and population infrastructure on the cost of biodiversity loss in a country. In the long run, it is evident that international tourists' arrival, per capita GDP, and population density all have a significant and negative correlation with forest area, as if there is 1 % increase in inbound tourism, per capita GDP and population density, forest area deteriorated by −0.110, −0.108, and −0.554 %, respectively. The depletion of forest area largely pronounced by population density, followed by inbound tourism and per capita GDP of a country. In a next regression apparatus, food exports have a significant and negative correlation with per capita income in a short run, while this relationship disappeared in the long run. In the long run, there is a significant and positive relationship between food exports and population density, while inbound tourism has no statistical significant relationship with food

Table 4 Estimates of ARDL cointegrating and long-run form

Variables	$\ln(FAREA)_t$	$\ln(FEXP)_t$	$\ln(FIMP)_t$	$\ln(CO2)_t$	$\ln(FFUEL)_t$	$\ln(GDPPC)_t$	$\ln(POPDEN)_t$	$\ln(INBOUND)_t$
$\Delta \ln(FAREA)_t$	—	—	—	—	—	−0.637	−0.506*	−3.161
$\Delta \ln(FAREA)_{t-1}$	−0.124	—	—	—	—	0.196	−0.105	0.363
$\Delta \ln(FAREA)_{t-2}$	−0.098	—	—	—	—	0.628	−0.043***	−3.360*
$\Delta \ln(FAREA)_{t-3}$	0.166***	—	—	—	—	−1.087	—	—
$\Delta \ln(FEXP)_t$	—	—	—	—	—	0.093***	−0.001	−0.012
$\Delta \ln(FEXP)_{t-1}$	—	0.656*	—	—	—	—	0.0008	−0.058
$\Delta \ln(FEXP)_{t-2}$	—	—	—	—	—	—	0.008*	0.082
$\Delta \ln(FEXP)_{t-3}$	—	—	—	—	—	—	0.010*	—
$\Delta \ln(FIMP)_t$	—	—	—	—	—	−0.302*	0.002	0.121
$\Delta \ln(FIMP)_{t-1}$	—	—	0.926*	—	—	0.082	—	0.010
$\Delta \ln(FIMP)_{t-2}$	—	—	0.620*	—	—	−0.047	—	−0.164***
$\Delta \ln(FIMP)_{t-3}$	—	—	0.295***	—	—	—	—	−0.190**
$\Delta \ln(FFUEL)_{t-1}$	—	—	—	—	0.277	—	—	—
$\Delta \ln(FFUEL)_{t-2}$	—	—	—	—	−0.271	—	—	—
$\Delta \ln(INBOUND)_t$	−0.071*	0.144	0.809**	0.809**	0.262**	−0.084	0.017**	
$\Delta \ln(INBOUND)_{t-1}$	−0.006	—	—	−0.299	−0.154	0.208***	—	−0.653*
$\Delta \ln(INBOUND)_{t-2}$	−0.041**	—	—	−0.202	0.004	−0.329*	—	−0.260
$\Delta \ln(INBOUND)_{t-3}$	—	—	—	0.869**	0.401*	−0.394*	—	—
$\Delta \ln(GDPPC)_t$	−0.005	−1.578*	−1.729*	0.428	−0.120***	—	0.010	0.488
$\Delta \ln(GDPPC)_{t-1}$	0.009	—	—	−1.939*	—	0.232	—	0.258
$\Delta \ln(GDPPC)_{t-2}$	0.069*	—	—	2.375*	—	0.381**	—	0.566***
$\Delta \ln(GDPPC)_{t-3}$	—	—	—	−1.463*	—	0.645*	—	—
$\Delta \ln(POPDEN)_t$	0.095	−4.845	−6.696	0.290	3.740***	0.872	—	−17.952**
$\Delta \ln(POPDEN)_{t-1}$	−0.919	−5.576	−10.566***	—	−2.840	−4.691**	1.033*	9.361
$\Delta \ln(POPDEN)_{t-2}$	0.830**	—	27.252*	—	—	—	−0.415*	4.186
$\Delta \ln(POPDEN)_{t-3}$	—	—	−32.164	—	—	—	—	—
CointEq(−1)	−0.603*	−0.306*	−2.156*	−0.483*	−0.452*	−0.907*	−0.350*	−0.350***
Long-run analysis								
$\ln(INBOUND)_t$	−0.110*	0.469	0.684*	−0.951**	−1.067*	0.026	0.050***	—
$\ln(GDPPC)_t$	−0.108*	2.292	−0.556*	0.436	−0.266***	—	0.076**	2.803***
$\ln(POPDEN)_t$	−0.554*	10.542**	5.066*	0.602	2.307**	0.511	—	−8.967***
$\ln(FAREA)_t$	—	—	—	—	—	−1.417	−1.057*	−4.274
$\ln(FEXP)_t$	—	—	—	—	—	0.177*	−0.051*	−0.321
$\ln(FIMP)_t$	—	—	—	—	—	−0.517*	−0.018	2.420**
Constant	9.164*	−76.557**	−26.619*	10.650	14.359*	13.287	6.995*	40.943***

Table 4 (continued)

Variables	ln(FAREA)$_t$	ln(FEXP)$_t$	ln(FIMP)$_t$	ln(CO2)$_t$	ln(FFUEL)$_t$	ln(GDPPC)$_t$	ln(POPDEN)$_t$	ln(INBOUND)$_t$
Diagnostic tests								
Jarque-Bera Test	1.255	1.146	1.795	1.524	0.715	1.065	0.349	0.981
Breusch-Godfrey Serial Correlation LM Test	0.008	0.244	5.492**	0.580	0.166	0.887	5.415**	0.860
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.967	0.757	2.632**	0.372	1.382	1.013	0.759	1.387
Ramsey RESET Test	0.633	1.648	0.085	0.378	3.260***	4.773***	0.605	2.343**

Note: *, **, and *** indicate 1, 5, and 10 % level of significance. Trend specification: linear trend. CointEq(−1) indicates error correction term

exports in a country. In relationship between food imports with inbound tourism, per capita income and population density show that inbound tourism has a positive and significant relationship with food imports, while per capita income considerably decreases food imports both in the short and long run. The impact of population density on food imports is mixed in short run; however, in the long run, population density significantly exacerbated the food imports in a country. The results are consistent with the previous studies of Collins (1999), Buckley (2002), Neto (2003), Sunlu (2003), Pickering and Hills (2007), Freytag and Vietze (2009), Din et al. (2014), etc. Sustainable tourism required strong policy framework in order to conserve natural capital that would facilitate the economy in their eco-environmental policies to sustained developmental goals by attracting international tourists in their pleasure destinations (Collins 1999). It is prerequisite to balance the eco-environmental policies in order to promote sustainable tourism and pro-poor tourism at both national and international levels (Neto 2003); further, it may mediate through financial incentives, environmental management, and regulatory measures for stable eco-tourism in a region (Sunlu 2003). The sound research is needed to focus on recreational ecology research to conserve natural ecosystem for our sustainable future (Pickering and Hills 2007). Tourism development affects biodiversity and climate change (Hall 2010) that compromised sustainable tourism agenda (Schloegel 2007). The climate change mitigation policy is desired for promotion of eco-tourism, land-use management, planning, and impact analysis (Buckley 1999). The collaborative work is required for pronunciation of environmental governance for sustainable tourism development across the globe (Erkuş-Öztürk and Eraydın 2010).

The short-run regression coefficients for CO_2 emissions and associated factors including inbound tourism, per capita income, and population density indicate that inbound tourism damages the natural environment of a country, as CO_2 emissions increase due to massive international tourists' arrival in a country; however, this result is no more sustained in the long run, where along with increase inbound tourisms, CO_2 emissions considerably decrease due to sustainable environmental reforms in a given country. On the other hand, inbound tourism and population density both increase fossil fuel energy consumption in a short run, while in the long run, inbound tourism decreases fossil fuel energy consumption; however, population density still increases fossil fuel energy consumption in a country. The per capita income has a negative and significant relationship with fossil fuel energy consumption both in the short and long run. The results are consistent with the previous studies of Gössling (2000), Becken and Patterson (2006), Lee and Brahmasrene (2013), Zaman et al. (2016a, b), Yorucu (2016), etc. The carbon offsetting schemes are helpful to formulate long-term sustainable tourism (Gössling et al. 2007), while imposing tax on carbon emissions further expedites the process of tourism development (Tol 2007) that aid to reduced "inspirational" greenhouse gas emissions across the countries (Scott et al. 2010). Tourism induced fossil fuel energy has a deleterious impact on environment, while "afforestation" is the desirable strategy to reduce the threat of climate change. Renewable energy sources are helpful to integrate sustainable tourism policies across the globe (Gössling 2000).

The short-run elasticities of GDP per capita in relation with the inbound tourism, food exports, food imports, forest area, and population density indicate that food exports have a significant and positive relationship with per capita income, while food imports significantly decline the share of food production in a country. The impact of inbound tourism is unclear, while population density has a negative relationship with per capita income. In the long run, food imports have a larger share in terms of decreasing per capita income as compared to food exports for increasing per capita income of a country. The final regression apparatus shows that in the short run, inbound tourism and food exports both have a positive relationship with population density, while forest area considerably reduces due to expansion in population per square km of land area in a country. In the long run, inbound tourism and per capita income both have a positive relationship with population density, while forest area and food exports have a negative correlation with the population density. The results are consistent with the previous studies of Bianchi (2004), Mbaiwa (2005), Lee et al. (2009), Castellani and Sala (2010), Paci and Marrocu (2014), Luo et al. (2016), etc. These studies confined the need to support global sustainable tourism by food security, conservation of biodiversity and natural resources, and balancing the growth-specific issues.

In a final regression, inbound tourism serves as a dependent variable modeled by biodiversity, environmental factors, and growth specific factors in a given context of Austria. The results show that forest biodiversity is affected by tourism development, as inbound tourism deteriorates the biodiversity in a form of depleting the forest area in a country. Moreover, per capita income significantly increases inbound tourism in a short run while population density affected the tourism development in a country. Similar results have been obtained in the long run where per capita income and food exports significantly escalate the inbound tourism while population density plummet the tourism development in a country.

The cointegration equation (CointEq(−1)) indicates error correction term, which implies the long-run convergence of the given models, as all eight columns of estimation in the given Table 4 indicate the correct sign of the coefficient; therefore, we may safely conclude that the speed of adjustment toward equilibrium is reasonably high, and the given models have a long-run convergence toward the equilibrium. The remaining diagnostic statistics including Jarque–Bera test of normality, Lagrange multiplier serial correlation test, Heteroskedasticity test, and Ramsey RESET model stability test indicate that there is no normality issue in all eight estimation columns, where Jarque–Bera test rejects the null hypothesis of normality issue in the given models. The Lagrange multiplier serial correlation test confirms that out of eight models, six models reject the null hypothesis of existence of serial correlation, while remaining two models, i.e., column 3 of FIMP model and column 7 of POPDEN model, accept the existence of serial correlation in the given model. Serial correlation does not affect the unbiasedness or consistency of ARDL estimators; however, it may affect estimators' efficiency; therefore, we estimated number of models to overcome this problem. Heteroskedasticity test indicates that out of eight models, only model 3 contains a problem of unequal variance, which is probably due to exclusion of more variables from the model that incorporated in the model 6 and model 7. Finally, Ramsey RESET model stability test indicates that out of eight given models, five models indicate that the model is stable, while remaining three models, i.e., model 5, model 6, model 8, have an issue of model stability. There may be multiple reasons to find out; however, the one possible reason is that the data set of prescribed variables is highly volatile across the time period; therefore, we may anticipate in some models regarding the stability issues; however, it does not affect the consistency of ARDL estimators.

The study finally evaluated the causality relationships between the candidate variables and presented the results in Table 5 for ready reference.

Table 5 shows the causality relationship between the candidate variables and found that causality in most of the cases running from environmental factor and growth specific factors to inbound tourism, i.e., there is a unidirectional causality running from fossil fuel energy consumption to inbound tourism, and from per capita income to inbound tourism in a country. The other cause-effect relationships show that causality running from CO_2 emissions to fossil fuel energy consumption and population density but not vice versa. Forest biodiversity Granger causes per capita income and food import, but this causality is not vice versa. Per capita income has a causal relationship with food exports and food imports, but this causality is not moving the other way around. The overall Granger causality confirms the following key causality relationships, i.e.,

i) Existence of growth-led tourism hypothesis,
ii) Existence of growth-led food production, and
iii) Forest biodiversity stimulate per capita income.

The causal relationships have a distinct edge in order to formulate sustainable environmental policies in a given country context. The study further proceeds to examine the intertemporal relationship between inbound tourism, biodiversity, environmental quality, and growth specific factors for the next

Table 5 VAR Granger causality/block exogeneity Wald tests

	$\Delta \ln(INBOUND)$	$\Delta \ln(C02)$	$\Delta \ln(FFUEL)$	$\Delta \ln(GDPPC)$	$\Delta \ln(POPDEN)$	$\Delta \ln(FAREA)$	$\Delta \ln(FEXP)$	$\Delta \ln(FIMP)$
$\Delta \ln(INBOUND)$	———	1.403	1.206	1.885	0.560	2.715	0.899	0.870
$\Delta \ln(CO2)$	1.697	———	9.184*	3.172	5.751***	8.880**	0.546	2.587
$\Delta \ln(FFUEL)$	6.832**	1.909	———	0.490	0.119	2.898	3.472	0.840
$\Delta \ln(GDPPC)$	17.248*	1.316	0.342	———	3.141	1.900	4.805***	10.809*
$\Delta \ln(POPDEN)$	1.833	0.175	1.051	1.299	———	1.682	1.061	1.591
$\Delta \ln(FAREA)$	3.858	0.893	0.512	5.218***	0.689	———	2.768	5.169***
$\Delta \ln(FEXP)$	1.835	0.921	2.867	0.706	1.776	0.761	———	0.808
$\Delta \ln(FIMP)$	1.086	0.692	0.786	0.472	2.546	2.978	3.840	———

Note: *, **, and *** indicate 1, 5, and 10 % level of significance

upcoming 10-year period. Figure 2 shows the impulse response function to analyze the forecasted relationships between the variables for a period of 2016 to 2025.

The results show that forest area decreases along with an increase in inbound tourism, while a shock to food exports and food imports both have an indirect relationship with inbound tourism in a country. Environmental factors including carbon emissions and fossil fuel energy have a differential impact on inbound tourism, while GDP per capita increases along with an increase in inbound tourism and population density will influence inbound tourism for the next 10-year period.

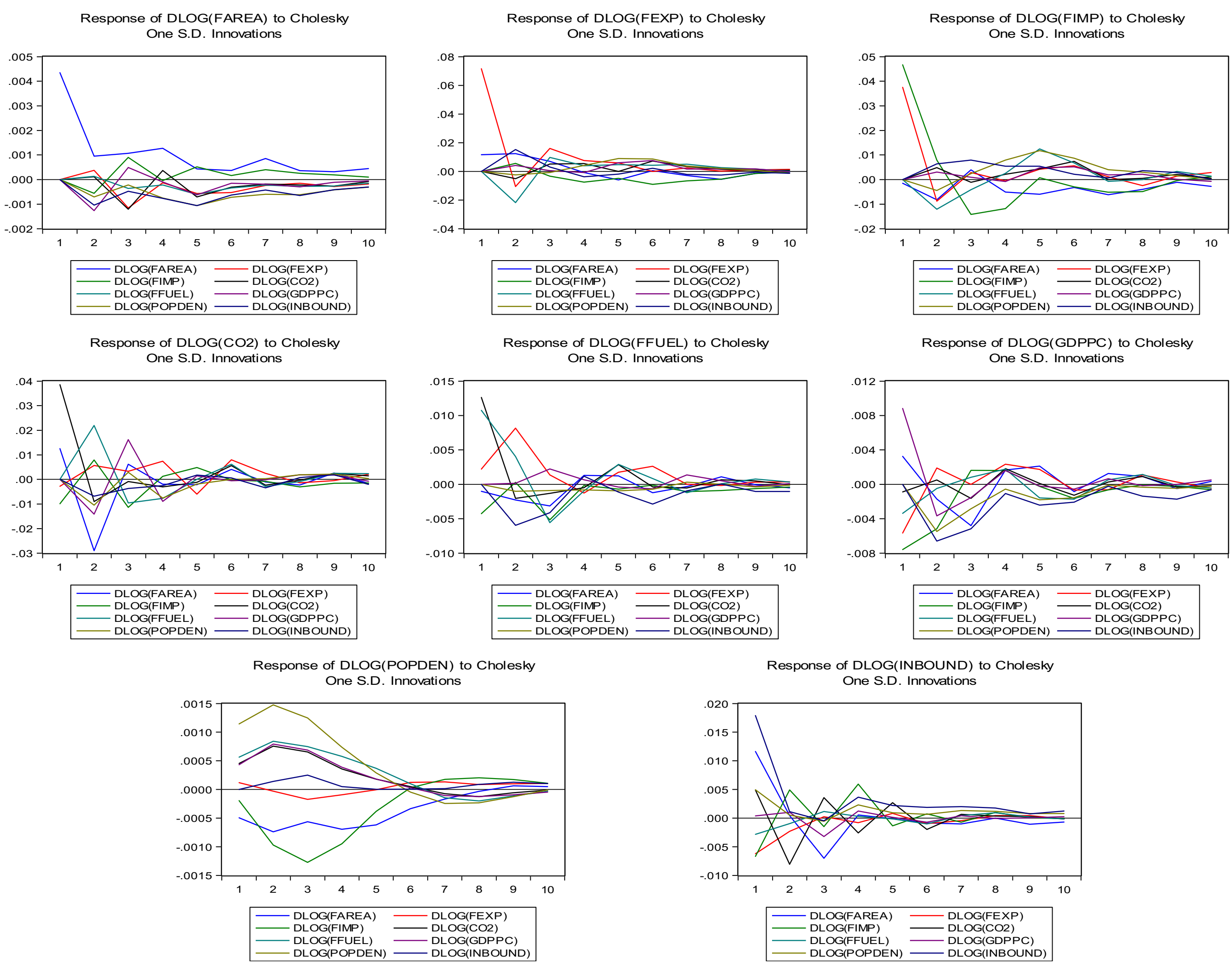

Fig. 2 Impulse response function

Conclusions

The interrelationships between international tourism, biodiversity loss, environmental sustainability, and growth issues are extremely complex and dynamic in nature that required strategic planning and wisdom to conserve natural environment by sustainable tourism policy framework. This study focused on all these four factors in the context of Austria by using the time series data from 1975 to 2015. International tourist arrival (inbound tourism) used for international tourism development; forest biological diversity includes forest area, food imports, and food imports; environmental sustainability referred CO_2 emissions and fossil fuel energy consumption while growth measures include per capita GDP and population density. These variables were selected because of vital importance in a given country context. The study employed autoregressive distributed lag (ARDL) model to investigate the long-run and cointegration relationship while multivariate Granger causality is used to evaluate the causal relationships between the candidate variables. The results show that forest area is affected by inbound tourism, per capita GDP, and population density, while inbound tourism and population density both significantly increase food imports in a country. Inbound tourism significantly increases CO_2 emissions and fossil fuel energy consumption in a short run, while in the long run, this result disappeared. Food imports have a negative impact on per capita income while food exports considerably increase economic growth. There is a negative relationship between forest area and population density while per capita income and inbound tourism both significantly associated with increased population density in a country. The causality results confirm the growth-led tourism and growth-led food production hypothesis while forest biodiversity Granger causes per capita income of a country.

Tourism-led growth and growth-led tourism both are two sides of the same coin. Tourism activities support economic growth while later shows that economic growth stimulates international tourism, both have distinct policy implications. The results of the study show that economic growth is the vital factor for promoting international tourism; therefore, we validate the “economic-driven tourism growth hypothesis” in a given country context. The policies to promote and sustain economic growth automatically lead to support international tourism that put forward to build strong mechanism for the healthy and sustainable environment in a country. The environmental impacts of international tourism are the main impediment to the sustainable tourism agenda globally. International tourism has a devastating impact on environmental degradation that required strong policy and regulatory measures in order to conserve our natural bonanza. Tourism induced fossil fuel energy consumption to deteriorate the environmental quality, which required identifying more friendly energy sources to mitigate the intensity of carbon emissions from the atmosphere. International tourism is jeopardy for biological diversity and ecosystem, which remains threatened the United Nations–Kyoto Protocol for environmental sustainability. The policy intervention and regulatory measures required to support the conservation of natural areas, wildlife, potential habitat area, and all ecosystems including deserts, mountains, wetlands, rain forests, etc. that required proper tourism planning in order to balance biodiversity and ecosystem. Sound and effective ecosystem management policies would be helpful to promote global sustainable tourism. By inclusion of “green” tourism products in a sustainability agenda is further helpful to attract international tourists, while it has transformed in to the process of rapid economic transformation in a country.

The empirical results contributed in to an existing knowledge, policy, and practice, as this study amalgamates the sustainable environmental indicators including conservation of biodiversity, air quality indicators, growth specific factors, and international tourism that aid to formulate long-term sustainable tourism policies in a country. We have to strictly comply to the United Nations–Kyoto Protocol for ecological conservation and broad-based sustainable growth. The green supply chain process that provides logistics support to the tourism minimizes the risk of climate change and global carbon emissions. Optimal use of land and natural resources, renewable energy sources, development of eco-tourism packages for nature conservation, improvement in natural heritage for cultural diversity and tourist’s attraction, promotion of natural assets, address the food security and environmental challenges, sustainable forest management and promoting natural reserves, integrating economic and environmental decisions and international cooperation for sustainable tourism all are the desirable policy tools for nature conservation and sustainable tourism.

Unsustainable international tourism is jeopardy for biodiversity loss; therefore, it is necessary to take some precautionary steps to preserve our natural environment, including legal land-use distribution, and high political will to promote sustainable tourism across the globe (Buckley 2002). International tourism development triggered the intensification of CO_2 emissions, which threatens the policy agenda of sustainable tourism development. The eco-tourism policies were helpful to reduce the environmental concern and would be helpful to integrate sustainable policies across the globe (Yorucu 2016). Ecological, social, and environmental sustainability are the three main pillars of environmental sustainability that required proper attention and care for building sustainable tourism agenda in constraint environment. Assurance of environmental sustainability attracts the international tourists’ to spend their leisure times in healthy and wealthy pleasure destinations. Sound and effective regulatory measures not only promote sustainable tourism while it raises the economic and social benefits all across the globe.

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