



Modelling the economics of sustainable tourism

Federico Inchausti-Sintes 

Department of Applied Economics Analysis, University of Las Palmas de Las Palmas de Gran Canaria,
Facultad. de Economía, Empresa y Turismo, Las Palmas de Gran Canaria, Spain

ABSTRACT

To date tourism has been synonymous with intense territorial use, which has led to a reconsideration of the relationship between tourism and its location in order to foster more environmentally-friendly development. In this context, the paper provides a novel approach to the analysis of tourism and the environment by developing a theoretical general equilibrium model addressing the integration of the environment in the economic system (i.e. in a *circular economy*) from a tourism perspective. The model's innovative aspect is in assuming the use of land not only as an input, but as an output. Specifically, the land is no longer supplied in a fixed quantity to the economy, but society decides between its enjoyment or its rental as a factor of production; thereby achieving a more rational use of this resource. Likewise, its consideration as an output allows us to stress its role as an asset; implying that its preservation also contributes to economic growth. The main findings show that, when the environment is integrated into the economic system, tourism is not a source of ecological depletion, but rather an essential contributor to its preservation. However, this necessary integration does not keep tourism from eroding sectoral diversification and reinforcing import dependence.

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Introduction

There is a concern, at all levels, about the need to develop a more *pro-environment* economy. This is where, in parallel to the use of greener sources of energy and technology, the economy is capable of integrating the environment in a more rational and sustainable way; into the so-called “*circular economy*”. Among all the economic sectors, tourism represents an interesting case study. Firstly, tourism can be considered a double-edged sword that is capable of generating considerable economic growth with its development, but with the potential cost of inflicting significant ecological damage (Gössling, 2001, 2003; Ozturk et al., 2016; Han, 2019; or Haraldsson & Ólafsdóttir, 2018) or social rejection when the development negatively affects the way of living and/or traditions of local residents (Saveriades, 2000; Kousis, 2000; Andereck & Nyaupane, 2011; Lo et al., 2014; and Tokarchuk et al., 2020). Secondly, the *embodied* nature of its productive-mix, where the tourist is an active agent in both the supply and production of the tourism offer, represents both a limitation and an opportunity. A limitation because, contrary to other *non-embodied* activities, it restrains the adoption of more efficient and productive methods of production,

which also affect its productivity and thus, income increases in the long term. An opportunity because its supply is not just limited to tangible goods, but embraces the concept of experience (Pine, Pine & Gilmore, 1999; Buhalis & Sinarta, 2019; and Sugathan & Ranjan, 2019), leaving room for important value-added gains, while compensating for the aforementioned lack of productivity gains. The need to strike a balance between tourism and the environment is even more critical in traditional tourism destinations, with most entering or currently immersed in a phase of stagnation and overcapacity (Aguiló et al., 2005; Bardolet & Sheldon, 2008; Chapman & Speake, 2011; Farmaki, 2012; Ivars-Baidal et al., 2013; and Rodríguez et al., 2008; and Dodds & Butler, 2019). In sum, like any other economic agent or sector, tourism needs to adopt more pro-environmental methods of production and consumption. However, the sector also has the opportunity to integrate the environment into its production, thereby demonstrating that a better environment is not only necessary, but profitable. The success of the latter approach is vital to ensure a holistic, fruitful and long-term relationship between both tourism development and the environment.

With this latter idea in mind, this paper develops a theoretical general equilibrium model addressing the integration of the environment in the economic system from a tourism perspective, by emphasizing its economic, environmental and social implications. Authors such as Alavalapati and Adamowicz (2000), and Nowak and Sahli (2007) have already adopted a similar methodological approach, but have assumed the land as an input that is inelastically supplied by society. In this study, both assumptions will be relaxed to highlight new findings in the complicated relationship between tourism and the environment. More specifically, the model relies on two key assumptions: firstly, that the land is no longer supplied in a fixed quantity to the economy, but that society decides between its enjoyment or its rental as a factor of production (input), which allows us to better value the social cost of this resource. Secondly, that the land is also considered as an output; stressing its role as a valuable good that can both boost and enrich tourism supply. These two central assumptions in the model allow us to identify productive and novel findings to achieve sustainable tourism development (i.e. it breaks the vicious circle between tourism development and depletion of the territory by enabling a more sustainable and profitable economic relationship between both). Unfortunately, this necessary integration between tourism and the environment does not keep the former from eroding sectoral diversification, which can trigger exchange rate appreciation or reinforce import dependence, which are the classical consequences of tourism specialization.

Literature review

Tourism and the environment

As noted by Briassoulis and Van Der Straaten (2013) and Pulido-Fernández et al. (2019), tourism interacts with the environment in a two-way process (i.e. it has the potential to cause both positive and negative impacts on the environment). On the one hand, a lot of tourism is built on environmental attributes such as flora and fauna, wildlife habitat, forests, beaches or mountains; which require good preservation and a highly valued resource base. However, on the other, its development causes, precisely, a depletion and overexploitation of the latter. According to Hernández and León (2013), the latter is especially intense in the early stages of tourism development, while it is subsequently progressively substituted by the development of physical capital. The process may eventually collapse when this physical development finally exceeds the regeneration rate of the natural capital.

From an input perspective, the environment is seen as a natural resource whose exploitation is needed to produce tourism. Cohen (1978), for example, highlights the fact that the intensity of tourist site-use, the resilience of the ecological system and the potential of tourism to transform the environment comprise key factors in the environmental impact of tourism. That pressure may eventually exceed the 'carrying capacity' of the destination or the natural resource, not only

in environmental terms (Brown et al., 1997; Salerno et al., 2013; Han, 2019; and Haraldsson & Ólafsdóttir, 2018), but also socially, when certain levels of tourism development are negatively perceived by the host community (Saveriades, 2000; Kousis, 2000; Andereck & Nyaupane, 2011; Lo et al., 2014; and Tokarchuk et al., 2020). The environmental impact may be even more disrupted in small communities in developing regions as noted by Gössling (2001 and 2003) in Zanzibar. According to his study, while tourism brought higher local income to villages, and new work opportunities, its development also boosted the *commoditization* of local resources, by altering the traditional balance between the needs of the local community and the sustainability of the ecosystem. Movono et al. (2018) drew similar conclusions in the case of indigenous Fijian communities. In the early stages, tourism was positively received by these communities, but over time, its development displaced traditional activities, skills and knowledge associated with them, and led to varying ecological effects. Furthermore, the erosion was frequently intensified by the open-access nature of most tourist locations. In such circumstances, usage of these sites is often economically inefficient (Brown et al., 1997). Fortunately, León et al. (2015) have found that as soon as tourists are aware of the potential damage inflicted to the environment or to local communities, most adopt a positive attitude toward environmental policies and limits on capacity.

In recent years, tourism seems to be reaching another level with a new phenomenon identified as *overtourism* (Dodds & Butler, 2019), which implies a heavy impact on the local community as well as on the physical and environmental capacity of certain destinations, especially in urban centres in well-known cities. Following these authors, most local populations have opted to limit, for example, the number of cruise ships and amount of tourism accommodation; or charge entry fees to address it. This latter issue and its various potential outcomes exemplify the need to find a balance between tourism development, social welfare and the environment.

In many cases, the production process employed in tourism activities also increases pressure on the environment by introducing water malpractice, the generation and management of waste and/or sewage problems (Gössling, 2001; Koens et al., 2009; and Moscardo et al., 2001; Kapmeier & Gonçalves, 2018; and Camilleri-Fenech et al., 2020). Similarly, the tourism activities themselves can also contribute to the deterioration of, for instance, marine wildlife when snorkelling, diving or using boat anchors (Middleton, 1998; Gil et al., 2015; and Webler & Jakubowski, 2016). Eastwood et al. (2017) and Wong et al. (2019) have found similar environmental damage exerted by tourism activities in and around coral reefs. More generally, Koens et al. (2009) highlight the following potential environmental damage inflicted by tourism: land clearance and erosion; disturbance and biodiversity loss; increase in garbage; and air pollution. Further, Koens et al. (2009), and Stern et al. (2003) have also identified a positive indirect effect of pro-environmental practices in tourism development through the introduction of alternative and more sustainable land use, which can displace more damaging activities. Another alternative is to involve local residents in the adoption and development of responsible environmental behaviour toward tourism activities (Lee & Oh, 2018).

The adoption of both green technologies and practices in the tourism sector can reduce this environmental impact (Yaw, 2005; Pan et al., 2018; and Wang & Wang, 2018). In some cases, these environmental measures transcend their initial purpose and enhance the tourism experience (Neuhofer et al., 2014; Marsiglio, 2015; Kim et al., 2016; or Merli et al., 2019). For instance, Kim et al. (2016) have identified the fact that green practices are also well-perceived by customers in the hotel industry through an indirect perception of quality. Merli et al. (2019) find a positive and significant relationship between green initiatives in coastal tourism areas and the satisfaction and loyalty of customers. Marsiglio (2015) also emphasize the demand-side of tourism development by theoretically demonstrating that when tourists engage in greener activities, sustainable tourism is achievable. Likewise, albeit with a more direct intention, tourism destinations use greener technologies as a commercial strategy to differentiate them from the competition (Mycioo, 2006). Overall, as emphasized by Wang, Wang, Xue & Wang (2018), the increase in

eco-conscious consumers has facilitated the adoption of pro-environmental practices in the tourism sector.

The latter examples are relevant because they emphasize the simultaneous role of the environment as both an input and output in the tourism sector (Pigram, 1980). This double perspective reconciles nature conservation and income generation (Hearne & Salinas, 2002), while providing a more complete view of the reciprocal interaction between both realities. The very notion of 'ecotourism' points in this direction by highlighting the fact that the preservation of the environment may generate both ecological and economic value when tourists demand it (Duffy, 2008; and Fennell, 2014).

Based on the above, this study contributes to the literature by providing a comprehensive perspective of the consequences of environmental integration in the economic system through tourism. This integration specifically relies on assuming this double role of the environment, as input and output. The use of a theoretical general equilibrium model allows this task to be accomplished by showing the multiple and reciprocal economic effects exerted by the environment in the economic system.

The model

There are two interesting general equilibrium models that address, in one way or another, the relationship between tourism and the environment¹: those of Alavalapati and Adamowicz (2000) and Nowak and Sahli (2007). Briefly, the former focuses on modelling the environmental damage caused by tourism, while the latter aims at analyzing the impact of tourism in the use and distribution of land ('Beach disease'). In both cases, land is assumed as an input, and is inelastically supplied by society (as the 'representative agent'). More specifically, Alavalapati and Adamowicz (2000) assume a small open economy with two sectors. One is the resource sector (forestry, agriculture or energy) that requires labour and land and is a net exporter and price-taker in the international market. The second is the tourism sector that also requires labour and land, but whose production is demanded both domestically and internationally on a non-traded basis. In general, both sectors cause environmental damage when using land or producing their outputs. On the other hand, the authors assume that the environmental damage inflicted by the resource sector also negatively affects the tourism sector. Nowak and Sahli (2007) also adopt a small open economy framework, but distinguish between coastal and urban areas. The former is composed of two sectors: coastal tourism and agriculture; whereas the latter is formed by the urban sector (the remaining sectors of the economy). The two coastal sectors compete for labour and land, whereas the urban sector requires labour and capital independently of the other sectors. An essential assumption of this model is the behaviour of the labour market. The coastal area is assumed to operate under full employment, while the urban area generates unemployment. In this model, the assumptions by which the land is assumed as an input, and is inelastically supplied by society will be relaxed, whereas its role as an output is introduced; highlighting new findings in the complex relationship between tourism and the environment, as explained below.

Briefly, the model represents a small-open economy without government formed by three sectors: agriculture (*A*), manufacturing (*Ma*) and tourism (services) (*Tourism*). There are two factors of production: labour (*L*) and productive lands (*PrLand*). The former is supplied inelastically by the representative agent (*Ra*), and is required by all three sectors in order to produce. The latter is only demanded by agriculture and tourism. The representative agent also owns this resource (*Land*) but, it decides between its enjoyment (*Land*) or its rental, which is supplied elastically to the sectors in the form of *PrLand* (productive lands). This assumption better captures the social opportunity cost of these resources and thus, its impact on social welfare by allowing for society to obtain utility from its use. As noted at the beginning of this section, this assumption does not

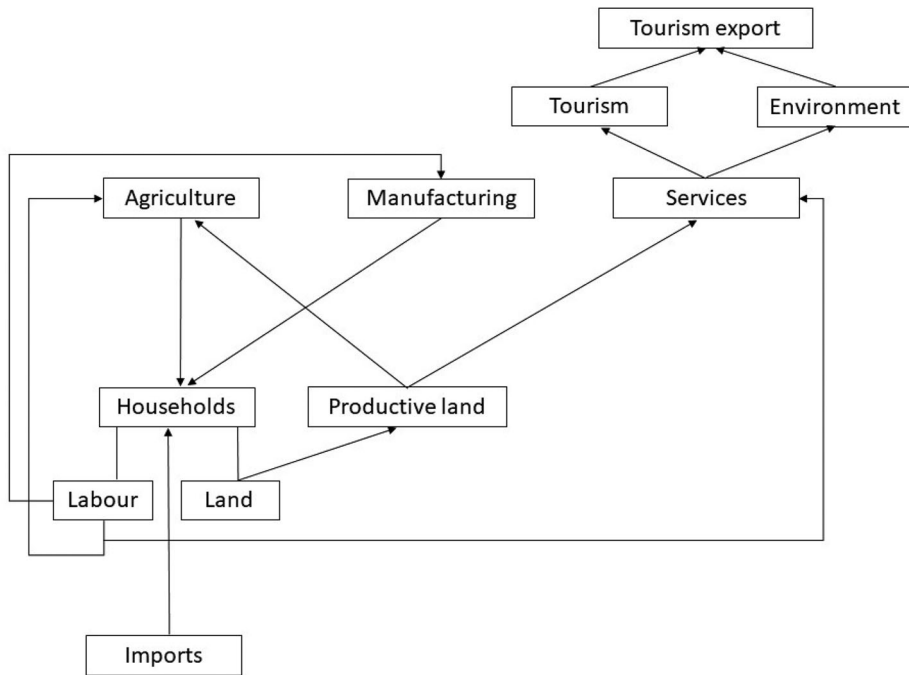


Figure 1. Structure of the model.
Own elaboration

hold in the aforementioned two general equilibrium models (Alavalapati & Adamowicz, 2000; and Nowak & Sahli, 2007).

Thank to these inputs (L and $PrLand$), the three sectors are able to produce their goods. The agriculture and manufacturing sector produce their respective single good (called sectors: A and Ma), while tourism produces two goods (joint production): tourism ($Tour$) and environment (E).² Both the agricultural and manufacturing goods are required domestically by the representative agent, while both tourism goods/services are demanded by the tourists ($Tour$) as an export. Finally, imports enter the model as final goods demanded by the Ra . Overall, the model assumes a deficit in the current account; reflecting the chronic negative foreign position (deficit) of tourism-led economies. The small-open economy assumption, implies that the economy is a price-taker in the international market. Figure 1 summarizes the structure of the model. Next this paper turns to the technical descriptions of the model:

Sectoral behaviour

Following Gilbert and Tower (2013), the modelization of joint production in a general equilibrium framework can be disentangled into two steps. Firstly, the tourism sector decides the optimal amount of both tourism ($Tour$) and environment (E) to be produced by maximizing the following equation:

$$\begin{aligned} \max_{T, E} \quad & P_T Tour + P_E E \\ \text{s.t.} \quad & Y^{tour} = t(Tour, E) \end{aligned}$$

Where P_T and P_E denotes the prices of $Tour$ and E , respectively, and are assumed as given. Y^{tour} refers to a composite good and t is the aggregator or transformation function. This function explains how the composite good (Y^{tour}) is transformed into either $Tour$ or E . Like any other production function used in microeconomic theory, t (lower case) is assumed to be continuous,

increasing in $Tour$ and E , convex, and homogenous of degree 1. The usual function form that fulfills the previous properties take the form: $t = \gamma_T [\delta_T Tour^{(1+T)} + (1 - \delta_T) E^{(1+T)}]^{1/(1+T)}$, where γ_T denotes a scale factor, δ_T and $(1 - \delta_T)$ represent the share of tourism and the environment in the composite good, while T (upper case) refers to the elasticity of transformation. Intuitively, the idea to disentangle the tourism product into tourism $Tour$ and the environment (E) aims at stressing that the tourism sector is not only composed of traditional tangible goods/services (accommodation, amenities and/or catering services), but also includes other environmental goods such as clean beaches, rivers and mountains; and/or well-preserved flora and fauna (i.e. the provision of tourism goods and services cannot be disassociated from the environment in which is provided); and whose sustainability and environmental value improve the tourism product as a whole. Taking into account the previous optimal decision, in the second step, the tourism sector can now decide on the optimal amount of labour (L^{tour}) and land ($PrLand^{tour}$) required to satisfy the production of $Y^{tourism}$ by maximizing the following expression:

$$\max_{L^{tour}, PrLand^{tour}} P^Y Y^{tour} (L^{tour}, PrLand^{tour}) - (P_L L^{tour} + P_{PrLand} PrLand^{tour})$$

P_L and P_{PrLand} refers to the prices of L and $PrLand$, respectively; and are assumed as given by the producer. Finally, the price of Y^{tour} , P^Y , coincides with the shadow price of the Lagrange multiplier obtained in the first step. Finally, assuming a Cobb-Douglas production, the constraint can be written as: $Y^{tour} = F(L^{tour}, Land^{tour}) = L^{tourism \alpha_{tour}} PrLand^{tourism (1 - \alpha_{tour})}$, where α_{tour} denotes the share of L and $PrLand$ in the production of the tourism sector $Tour$ (Y^{tour}).

Regardless of the mathematical apparatus, the key idea is that this sector is now capable of jointly producing its traditional tourism offer denoted by $Tour$ and a new environmental good (E); both being in demand by tourists. In sum, the model is capable of addressing both roles: the land in the economy as an input, and as an output (i.e. the tourism sector erodes the environment by demanding land but it is also aware of the importance of conservation and sustainability to generate added-value in the form of a better, and more well-preserved, environment).

The other two sectors, agriculture (A) and manufacturing (Ma), behave according to the following generic cost minimizing problem:

$$\begin{aligned} \min_{L^i, Land^i} & P_L L^i + P_{PrLand} PrLand^i \\ \text{s.t. : } & Y^i = F(L^i, Land^i) \end{aligned}$$

Where upper index i refers to the two sectors: A and Ma , Y^i denotes the production of A and Ma , respectively. L^i and $PrLand^i$ represents the optimal demand of both factor production made by sector i , bearing in mind that sector Ma does not demand land to produce. Thus, $PrLand^i = 0$, when $i = Ma$. Finally, both sectors are price-takers in P_L and P_{PrLand} . Assuming a Cobb-Douglas production, the constraint can be written as: $Y^i = F(L^i, Land^i) = L^{i \alpha_i} PrLand^{i(1 - \alpha_i)}$, where α_i denotes the share of L and $PrLand$ in the production of sector i (Y^i), where α_i denotes the share of L and $PrLand$ in the production of sector i (Y^i). With $\sum_{i=1}^2 \alpha_i = 1$.

As mentioned above, by mathematically resolving the previous problems, this economy obtains the optimal demand decision of inputs (L and $PrLand$) to be demanded from the representative agent/households, which use these incomes to satisfy their demand for agricultural and manufacturing goods (A and Ma). This economic behaviour can be comprehensively summarized as follows:

Household behaviour

The households maximize their total utility by optimally demanding agricultural and manufacturing goods (A and Ma), land, and imports (M , upper case). Mathematically, this optimal demand is obtained from the following problem:

$$\max_{A, Ma, M} P_{Ra} U^{RA}(A, Ma, Land, M)$$

$$s.t : m = P_A A + P_{Ma} Ma + P_{Land} \overline{Land} + P_{er} M$$

U denotes the utility function and P_{Ra} reflects the price level (cost of living) of the economy. The constraint represents the income constraint of the households. The left-side represents total income (m , lower case) that coincides with the revenue obtained from renting the fixed endowment of labour ($\bar{L}$) and the land ($P_L \bar{L}$ and $P_{Land} \overline{Land}$), and from the negative foreign position (deficit) ($P_{er} deficit$); implying that: $m = P_L \bar{L} + P_{Land} \overline{Land} + P_{er} deficit$). The right-side denotes the consumption of agricultural, manufacturing and imported goods multiplied by their respective prices. The open-economy assumption emphasizes the chronic current account deficit exhibited by tourism-led economies. In the case of imports, its price (P_{er}) represents the price of the exchange rate, which, given the structure of the model, equals the real exchange rate. Finally, assuming a Cobb-Douglas utility function the objective function takes the following form: $U^{RA}(A, Ma, Land, M) = A^{\beta_A} Ma^{\beta_{Ma}} Land^{\beta_{Land}} M^{\beta_M}$. Where, β_A , β_{Ma} , β_{Land} and β_M denotes the respective share of each consumption good in the total consumption basket. With $\beta_A + \beta_{Ma} + \beta_{Land} + \beta_M = 1$.

Tourist behaviour

Tourist behaviour is modelled similarly to households. The problem is as follows:

$$\max_{Tour, E} P_{Tourist} U^{tourist}(Tour, E)$$

$$s.t : TE = P_{Tour} Tour + P_e E$$

Where $U^{tourist}$ is the utility function and $P_{Tourist}$ reflects the cost of living for the tourist. Two aspects are worth highlighting. Firstly, although tourism demand is considered an export, it is consumed domestically (in the form of non-traded goods/services). Hence, it observes the domestic price of these goods. Secondly, it is important to also remember that both tourism goods ($Tour$ and E) are only consumed/enjoyed by tourists, as noted above in footnote 1. Finally, in order to consume these goods, tourists have to exchange their currency for local currency, meaning that the current account is balanced: $P_{er} deficit = P_{er} M - P_{er} TE$, where TE refers to tourism expenditure. Finally, assuming a Cobb-Douglas utility function the objective function takes the following form: $U^{Tourist}(Tour, E) = Tour^{\mu_{Tour}} E^{\mu_E}$. Where, μ_{Tour} and μ_E denote the respective shares of each consumption good in the total consumption basket. With $\mu_{Tour} + \mu_E = 1$.

The environment

Land is an endowment of the households. However, in this model, it is not supplied inelastically, like the workforce. As mentioned above, this assumption better captures the social opportunity cost of this resource by allowing society to decide between its enjoyment or its rental as a factor of production (input); similarly to the trade-off between leisure and work. In other words, this assumption yields that the price of the productive land ($PrLand$) equals the social opportunity cost of the land ($PLand$). Alternatively, it also implies that a part of the land is demanded by the productive sectors (A and $Tour$) (productive lands, $PrLand = PrLand^A + PrLand^{Tour}$), while the other part remains as part of the utility of the households ($Land$) and as part of the household endowment ($\overline{Land}$), implying that: $\overline{Land} = PrLand^A + PrLand^{Tour} + Land$. Mathematically:

$$\min_{Land} P_{PrLand} PLand^{Pr}$$

$$s.t : PrLand = F(Land^{Pr})$$

In sum, this mathematical problem allows the household to transform/exchange, endogenously, land for productive activities ($PrLand$) or for consumption/enjoyment by households

Table 1. Calibrated and initial values, and simulation results.

		Baseline scenario		Tourism shock scenario
Calibrated parameters:		Variables:		
T	1	A	1	0.993
δ_{tour}	0.46	Ma	1	0.992
$1 - \delta_{tour}$	0.54	Tour	1	1.001
α_A	0.33	Ra	1	1.075
$1 - \alpha_A$	0.67	Environment	1	1.002
α_{Ma}	1	Tourists	1	1.001
α_{Tour}	0.46	P_A	1	1.007
$1 - \alpha_{Tour}$	0.54	P_{Ma}	1	1.008
$\alpha_{Environment}$	1	P_{Tour}	1	1.008
μ_{Tour}	0.70	P_L	1	1.008
μ_E	0.30	P_{er}	1	0.916
β_A	0.02	P_{Land}	1	1.006
β_{Ma}	0.03	P_{PrLand}	1	1.006
β_{Land}	0.12	P_E	1	1.003
β_M	0.83	P_{ra}	1	0.930
-	-	$P_{tourist}$	1	1.007
-	-	m (numerarie)	172	172
-	-	TE	132	133.073

Own elaboration.

(Land). To meet this aim, this activity will demand a certain amount of land ($Land^{Pr}$) in an optimal way. Finally, the model also assumes a Cobb-Douglas production function: $PrLand = F(Land^{Pr}) = Land^{Pr}$.

Model discussion and implications

Central to the inquiry is the modelization and better interaction between the use of land and tourism development. In this sense, the land behaves as an input (factor of production), which is in demand from the agriculture and tourism sector. Hence, as soon as tourism demand rises, the demand for land also increases; intensifying the vicious circle between tourism development and use of the territory. However, this relationship can be altered by introducing two key assumptions.

Firstly, that the land is no longer supplied in a fixed quantity (i.e. it has perfectly inelastic supply; which is the standard approach when modelling the land as an economic input), but society decides between its enjoyment (preservation) or its rental as a factor of production (depletion). The main consequence of this assumption is that the price of the productive land ($PrLand$) equals the social opportunity cost of the land ($PLand$); producing better societal use of this scarce resource.

Secondly, that the land also behaves as an output produced by the tourism sector in line with the postulates of the circular economy. Hence, the environment is positively valued by tourists as part of tourism supply; meaning that tourism development is not only a cause of environmental degradation (land as an input), but also an important agent for its preservation (i.e. land is treated as an output; or a better environment). The inclusion of these two assumptions in the model produces innovative results and findings, as highlighted in the results and conclusions below.

Results

The model was programmed in GAMS. The data used for the simulation of the model and the tourism demand shock are not related to any tourism-led economy. Hence, the numerical example simply aims at providing a more pedagogical and visual explanation of the consequences and insights of the model. Specifically, other initial values will lead to different absolute

Table 2. Sensitivity analysis.

Variables:	$T = 0.1$	$\delta_T = 0.1$	$\alpha_A = 0.1$	Baseline scenario	$\alpha_A = 0.9$	$\delta_T = 0.9$	$T = 1.5$
A	0.993	0.993	0.994	0.993	0.993	0.995	0.993
Ma	0.992	0.994	0.992	0.992	0.993	0.992	0.992
Tour	1.001	1.001	1.001	1.001	1.001	1.001	1.001
Ra	1.075	1.075	1.075	1.075	1.075	1.076	1.075
Enironment	1.002	1.001	1.002	1.002	1.002	1.004	1.002
Tourists	1.001	1.001	1.001	1.001	1.001	1.001	1.001
P_A	1.000	1.007	1.006	1.007	1.007	1.005	1.000
P_{Ma}	1.001	1.006	1.008	1.008	1.007	1.008	1.001
P_{Tour}	1.000	1.008	1.008	1.008	1.008	1.009	1.000
P_L	1.001	1.006	1.008	1.008	1.007	1.008	1.001
P_{er}	0.910	0.916	0.916	0.916	0.916	0.916	0.910
P_{Land}	0.999	1.007	1.006	1.006	1.006	1.003	0.999
P_{PrLand}	0.999	1.007	1.006	1.006	1.006	1.003	0.999
P_E	1.000	1.003	1.003	1.003	1.003	1.003	1.000
P_a	0.924	0.930	0.930	0.930	0.930	0.930	0.924
$P_{tourist}$	1.000	1.007	1.007	1.007	1.007	1.007	1.000
m (numeraire)	172	172	172	172	172	172	172
TE	132.156	133.074	133.073	133.073	133.073	133.069	132.156

Own elaboration.

results, but the main findings will hold as shown below in the sensitivity analysis. Besides, the values of some parameters have been taken from real tourism economies to provide more realistic results. Table 1 shows the values used in the calibration of the parameters, the initial values of the variables and the results, following a rise in tourism demand of 10%. The values of the production coefficient shares (α_A , $(1 - \alpha_A)$, α_{Ma} , α_{Tour} and $(1 - \alpha_{Tour})$) have been obtained from the annual national accounts of a well-known tourist destination such as Spain³, whereas the sectoral share is adapted from Inchausti-Sintes (2020). According to this source, “agriculture and fishing” and “manufacturing” represent around 2% and 4% of total GDP of tourism-led economies, respectively.

According to the results depicted in Table 1, the tourism shock increases production in the tourism sector ($Tour = 1.001$) that, at the same time, triggers a shift in inputs (L and $PrLand$) from non-tourism sectors (A and Ma) to the former; pushing up salaries (P_L) and the cost of land (P_{PrLand}). As a result, both non-tourism sectors (A and Ma) cannot afford these higher costs and reduce their outputs ($A = 0.995$ and $Ma = 0.992$). While the reallocation of employment is at the expense of other non-tourism sectors, the reallocation of land is at the cost of both sectoral and social displacement. Focusing on the latter, society is initially consuming/enjoying land at a social cost of 1. However, the tourism demand shock increases the social opportunity cost of this resource ($P_{Land} = 1.002$), easing the “renouncement” (i.e. renouncement as a “consumption” good) of this resource for society. As a result, P_{Land} equals P_{PrLand} ; and the land available for production rises ($Environment = 1.002$). This result is specifically caused by assuming that the land is supplied elastically to the economy, which captures the social cost of this resource. Simultaneously, the tourism sector ($Tour$) is capable of compensating for this societal resource while increasing its joint production (i.e. ‘traditional tourism good’ and environment). Hence, tourism is not just a source of environmental depletion (the input-side), but an ally for its preservation (output-side).

The reduction in both A and Ma , and the displacement of land from society (Ra) to tourism generates a loss of welfare in the former. Nevertheless, taking into account the real exchange appreciation caused by tourism demand ($P_{er} = 0.918$), the representative agent is capable of demanding cheaper import goods. As a result, social welfare rises ($Ra = 1.009$). These results - sectoral non-tourism reduction, *de-industrialization*, and exchange rate appreciation - are three classic effects of tourism in the economy (Copeland, 1991; Adams & Parmenter, 1995; Narayan, 2004; Chao et al., 2006; and Inchausti-Sintes, 2015 and 2020); while these economic effects are symptoms of the economic illness known as “Dutch disease” (Corden & Neary, 1982; and Corden,

1984). In other words, more environmentally-friendly tourism cannot avoid its economic consequences.

Finally, some key parameters of the models are modified to test the sensitivity of the results to these changes. The parameters affected are the coefficients production share of the tourism sector and agriculture, δ_{tour} and α_a , respectively; and the elasticity of transformation (T). Both sectors are key in determining the use of land, while, at the same time, the tourism sector is the main agent in transforming the former into output. Specifically, the sensitivity analysis consists in taking extreme values (0.1 and 0.9) for δ_{tour} , α_a , and (0.1 and 1.5) for T , and checking the consistency of the results when compared with the base scenario. As shown in Table 2, the latter experiences marginal changes. Hence, the main findings and conclusions of the model hold.

Conclusions

This paper aims at modelling sustainable tourism economic development in line with the current social demand for a more environmental-friendly economic system, which is also known as a '*circular economy*'. Among the various ways of approaching this topic, the model relies on two key assumptions. Firstly, the environment is integrated into the economy not only as an input, which is the classical approach, but also as an output, by assuming a joint production function in the service sector (tourism-based activities; i.e., the tourism and agricultural sectors demand land but, at the same time, the former is aware of the need to preserve the environment as part of value-added tourism). Secondly, land is considered to be a societal endowment, but it is now supplied endogenously as a way of capturing the social opportunity cost of this resource. These two simple assumptions produce significant novel findings that can be summarized as follows:

The rise in the production of services, generated by tourism demand, causes an increase in the demand for both labour and land -pushing their costs up- and triggers a reallocation of resources from other sectors (such as agriculture and manufacturing). Furthermore, taking into account the fact that land is no longer supplied inelastically by society, the tourism sector has an alternative way of expanding its production by demanding this resource. Consequently, society will only supply this resource to the tourism sector as soon as the price paid by it equals the social opportunity cost of the land (P_{land}); thereby compensating for its social loss. More importantly, this change in the use of land from society to the economy implies a difference in the current paradigm of the lineal economy by ensuring an environmental improvement transaction for society as a whole (i.e. society renounces the use of this resource at the price of its social opportunity cost). However, in exchange, the tourism sector offers an alternative use of the land by offering it as an economic asset (a better environment) to tourists. In consequence, the economy in general, and tourism in particular, stop simply depleting the environment and become an important ally in its preservation.

Nevertheless, these novel and positive results do not prevent tourism from its classical economic consequences. This approach of sustainable tourism development keeps eroding sectoral diversification by increasing demand for the factors of production (labour and land); thereby pushing their prices up, as already noted. Consequently, non-service activities (agriculture and manufacturing) reduce their competitiveness with these new costs. Furthermore, tourism demand continues to favour real exchange appreciation that, together with the higher salaries paid by services (*induced effect*), increases the demand for imports, reinforcing the import dependence of tourism-led economies. As a result, imports account for most of the welfare improvement.

From a policy perspective, tourism can offer the environment as a consumption good; emphasizing that these kinds of *greener experiences* are a new value-added concept in the tourism value chain. For decades, the environment has been regarded as a resource upon which tourism infrastructures have been built; without noting the consequences on the former. This strategy

may be understandable in the first stages of tourism development, when a certain level of infrastructure is needed. However, in the long term, it exhausts the resources that favour its development and sustained its competitive advantage in the early stages.

In other words, tourism output is also composed of environmental attributes (including beaches, mountains, climate and/or flora and fauna) that can only be enjoyed when travelling to these places. In sum, the greater the preservation of these environmental pull factors, the higher the added-value generated and the greater the differentiation from other potential competitors. This new market niche might be especially useful when taking into account ever-increasing international competition that drives differential product strategies. In this same context, the chronic lack of significant productivity gains in tourism-based activities stresses the need to adopt these new environmental-friendly strategies capable of generating the value-added needed to compensate for the lack of the former and ensure the long term growth of incomes (wages and benefits).

Finally, it is important to note that the model has at least two main limitations. Firstly, it does not explicitly consider the generation of waste and its treatment, which is also an important aspect to be addressed to achieve sustainable tourism and economic development. Secondly, the land modelization as a societal endowment with property rights, albeit useful for a community of individuals to allocate goods, does not ensure that the use of the land is fully sustainable in term of the environment (i.e. the latter does not find its balance under the rationale of a market or property rights). Perhaps, a more restrictive way of allocating environmental goods should be adopted in the future to achieve truly sustainable development. These limitations are a matter for future research.

Notes

1. Hernández and León (2013) and Marsiglio (2015) also provide interesting and similar metodological approaches to the interaction between tourism and the environment. Nevertheless, they both specifically focus on the latter relationship and omit other sectoral and economic interactions.
2. While in real life both land and environment refer to the same concept, the model distinguishes between them as a way of emphasizing the private use of the environment by the tourism sector, from the use of it made by the rest of society. Moreover, it also emphasizes the preservation and improvements made by this sector when demanding land and generating added-value through its preservation as a tourism attribute (better environment). This assumption could be relaxed by assuming both variables as equal, yielding similar results to the base model. The only difference is that the price of the land falls, instead of rising, because of the new land supplied by the tourism sector.
3. Retrieved from the Spanish National Statistical Institute: https://ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736177058&menu=resultados&idp=1254735576581

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No potential conflict of interest was reported by the authors.

ORCID

Federico Inchausti-Sintes  <http://orcid.org/0000-0003-0292-3071>

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