

Article

Sustainable Tourism, Social and Institutional Innovation—The Paradox of Dark Sky in Astrotourism

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Abstract: Astrotourism is an emerging type of sustainable tourism based on the observation of the dark sky, free of light pollution, and of all the experiences that have developed around it. The views and perceptions of the main social actors and their constellations and interactions are considered. Both the public decision-makers concerning astrotourism and the civil society involved were analysed in this research through a case study in Aragon, an inland Spanish region. New institutionalism in sociology based on the actors provides a coherent structural framework and explanation of the most relevant aspects in astrotourism in Aragon as well as help to understand the social and institutional innovation, in the sense that civil society has organised itself for many years to show and bring astronomy closer to the social majority; in light of this social reality, institutions have had to respond appropriately, taking and allowing for the participation of astronomical associations, in order to develop tourist experiences in relation to the appropriate dissemination of this science. Even more so, we studied the socioeconomic dynamics and territorial impacts. Thanks to the application of a qualitative method, specifically, semi-structured interviews with relevant informants in the territory, we discovered a hidden relevant social situation around astrotourism. Is the so called “paradox of dark sky” that emerges in communities where social welfare gains such as widespread access to artificial light are jeopardised by a new collective approach to artificial light control and light pollution that prevents high-impact emotional experiences around the dark sky, but takes into account that astrotourism is an opportunity for the endogenous and sustainable socioeconomic development of these forgotten areas.

Keywords: astrotourism; case study; sustainable tourism offer; territorial development



Citation: Escario-Sierra, F.; Álvarez-Alonso, C.; Moseñe-Fierro, J.A.; Sanagustín-Fons, V. Sustainable Tourism, Social and Institutional Innovation—The Paradox of Dark Sky in Astrotourism. *Sustainability* **2022**, *14*, 6419. <https://doi.org/10.3390/su14116419>

Academic Editors: Alan Fyall and Brian Garrod

Received: 29 March 2022

Accepted: 21 May 2022

Published: 24 May 2022

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1. Introduction

The so-called astronomical tourism or astrotourism attracts people travelling to destinations where they can enjoy the dark sky, free of light pollution [1]. It is considered as an original and sustainable kind of tourism that uses the sky as the main resource for its implementation and development [2,3] and can be studied as a form of special-interest tourism (SIT) [4]. The concept given by [5] defines it as “tourism using unpolluted night skies as a natural resource for astronomical, cultural or environmental activities” (p. 5). It opens a way to develop sustainable tourism products related to the dissemination of astronomy and the scientific, cultural, and environmental heritage associated with the sky [6,7]. The territories in which it is practiced are mainly rural, semi-urban, or non-industrialised areas, far from large cities and away from light pollution, considering that light pollution is produced both by the excessive use of artificial light and its misuse [1,8,9].

This type of tourism is also available in areas that, due to their meteorological conditions, facilitate starry sky observation, and this research is based on a case study focused on Aragon, a Spanish region. This fact implies a competitive advantage for those depopulated

and peripheral areas with a low-degree of industrialisation and urbanisation [10]; therefore, astrotourism implies the improvement in the social capacities developing in these kinds of territories, both from the public-policy processes and from private initiatives, mainly by increasing the territorial self-esteem, the drive of entrepreneurship, and the application of new ways of labour and tourist service offerings [11]. Specifically, Aragon is highlighted because three of its counties, Sierra de Albarracín, Gúdar-Javalambre and Cuencas Mineras, are considered as “Starlight Territory” as these zones have obtained the double certification of being a Starlight Tourist Destination and Starlight Reserve from the Starlight Foundation. The certificates guarantee that these places are ideal for the contemplation of the starry sky and, even more, form a network throughout the world. This, together with the nine Starlight awards and one Stellar Park that have been achieved in the province of Teruel, make the region a very important case study. Aragon has four astronomic observatories situated in the territory in locations such as Huesca, Teruel, Javalambre, and Montalbán, and the number of visitors, which is around 100,000 people per year, is also growing [12].

1.1. Geographical and Institutional Context

Aragon is an inland region of Spain located in the north of the Iberian Peninsula and bordering France. Tourism in Aragon is considered as one of the key sectors for the territorial planning of the Autonomous Community of Aragon, hence its inclusion is one of the key activities in the Spatial Planning Strategy of Aragon [12].

Aragon has one of the lowest population densities in Europe (24.8 h/km^2), which is significantly lower than in Spain (78.8 h/km^2) and below the European average (116 h/km^2). The number of inhabitants per square kilometre in some parts, especially in the provinces of Huesca and Teruel, corresponds to what is known as a demographic desert, areas with an average population density of fewer than 10 inhabitants per square kilometre [13], which occurs in a total of 14 Aragon’s counties, which represents 47.10% of the surface area of Aragon. Astrotourism is classified as a ground-breaking type of tourism that is tending to emerge, being able to use resources for its development outside of the high season, thus helping to deseasonalise the tourist demand [14,15]. The development of this type of tourism in Aragon refers to the role played by the quality of the sky, specifically, the absence of light pollution and how the use and conservation of this resource can influence the improvement in the local economies of rural areas. Depopulation is one of the main challenges that Aragon faces in the 21st century, and this situation of low-population density is coupled with a significant territorial imbalance, with the majority of the population concentrated in certain areas, especially in the metropolitan area of Zaragoza [16]. Aragon’s municipalities are grouped into three categories: rural areas (municipalities with 0 to 2000 inhabitants), intermediate areas (municipalities with 2001 to 10,000 inhabitants), and urban areas (municipalities with more than 10,000 inhabitants). In the data obtained from the grouping of municipalities according to their population, 92.1% of the municipalities belong to rural areas but their population only represents 16.16% of the population of Aragon (210,280 inhabitants), while only 1.8% of the municipalities belong to urban areas, which in turn represents 69.48% of the total population [16].

The migratory process that began at the end of the 19th century from the rural areas of Aragon to other settlements where industrial development was successfully taking place has been identified as the main cause of the depopulation. At the end of that century, Aragon’s economy was essentially agrarian. With industrialisation, the young population in the rural areas of Aragon began to migrate to cities with greater economic dynamism and that offered more employment opportunities such as Madrid, Valencia, or Barcelona [17]. Nowadays, negative natural growth has replaced emigration as the main cause of depopulation, a phenomenon that is aggravating the situation in most of the counties that already have problems of depopulation. The lower number of births compared to the number of deaths in Aragon is mainly due to two causes [18]: a low fertility rate, with the number of births in Aragon per woman of childbearing age (1.08) being lower than that in Spain as a whole (1.1) and even lower when compared to the

European average (1.44) [16], and the low percentage of women of child-bearing age in counties with an ageing population [14].

1.2. The New Institutionalism in Sociology

New institutionalism in sociology (NIS) is proposed as a comprehensive basis for this research. We start from three social problems that are present in the region of Aragon, namely, a high level of depopulation; the lack of complete services, certain isolation, and less development of the peripheral areas; and together with this, a high tourist seasonalisation.

In this study, we followed the explanatory logic of the NIS, observing how public policies are materialised in relation to the general plan of tourism, light pollution, and regulations in relation to sustainability, as astrotourism is a type of tourism that helps to improve the social problems detected. We considered how the interactions and strategies of the social actors were involved in a determined institutional arrangement, how a specific policy environment have impacts on the territory of Aragon (Spain), and how social and institutional innovation has emerged [19–21]. Specifically, referring to the concrete institutional arrangements of the NIS around astrotourism, the centre-periphery theory was used because it is a spatial metaphor describing and attempting to explain the structural relationship between the advanced ‘centre’ and a less developed ‘periphery’. This is also because in this case, the lesser development of the periphery, depopulation, and all of the environmental consequences that this entail, becomes a territorial competitive advantage for the practice of astrotourism [22]. As such, it is important to consider astrotourism as a new challenge in front of peripheral depopulation and as a solution to the seasonal adjustment of tourism [23]. The relationship among the different elements is represented by the structure developed by Scharpf (2018) and Mintrom (1998) [21,24] (Figure 1).

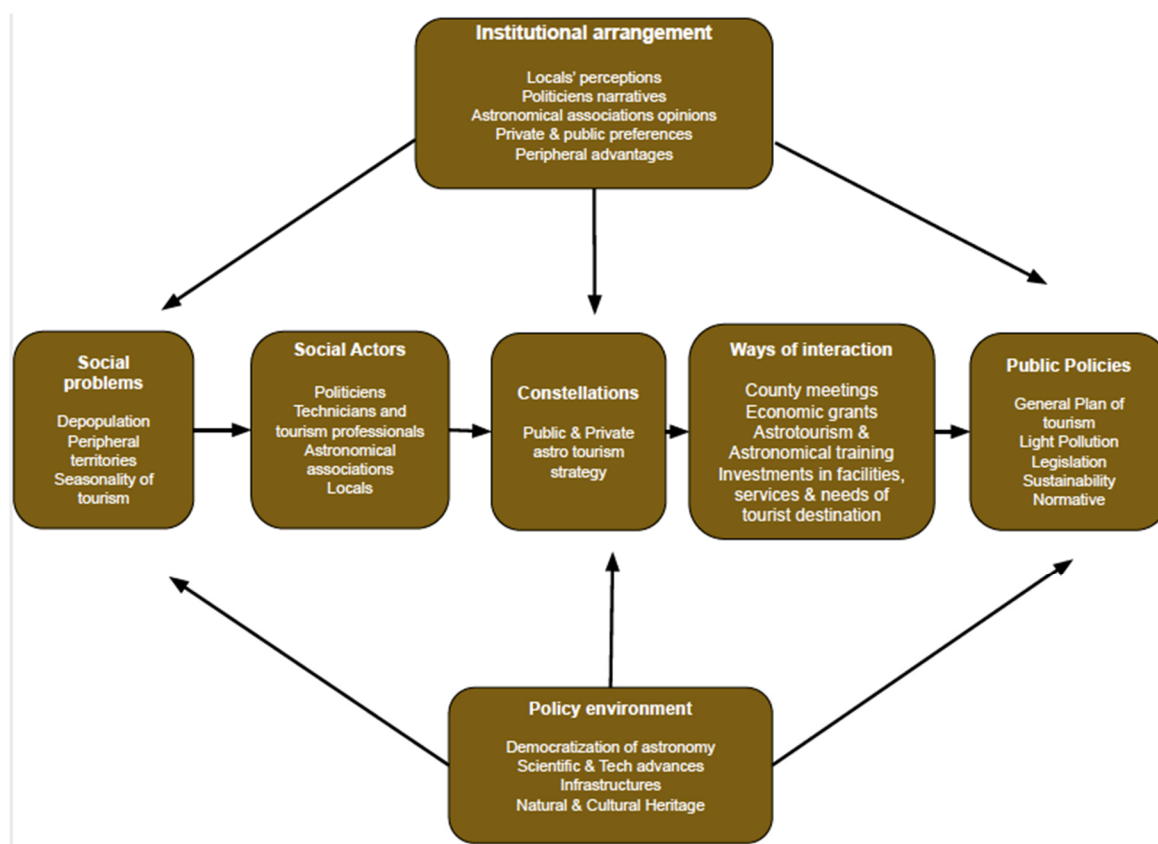


Figure 1. New institutionalism in sociology and astrotourism, partially adapted from Zurbriggen (2006); Scharpf (2018) and Mintrom (1998) [19,21,24].

1.2.1. Policy Environment: Public Interest for Astronomy and Its Heritage

Starlight and other celestial bodies have always enriched the terrestrial nature as well as the human habitat, creating landscapes perceived by different cultures as an integral part of their natural and cultural heritage [25]. The cosmos has captured the imagination of civilisations throughout history as well as the efforts of different cultures to understand what they saw in the sky. All these have been reflected in the architecture, petroglyphs, and other cultural materials [26,27]. The sky permanently constructs our existence as part of an environmental and existential whole; we give the sky a physical and symbolic value. In the past, it was an element of exclusive access for astronomers, but nowadays, the night is a natural resource, a spatial reality to be developed and preserved [28]. The starry sky acts as a democratised object, and is considered as part of the natural and cultural heritage to be preserved [29]. Authors such as Kovalevsky (1993) [30] have stated that “the night sky represents through its stars the message of our place in the universe, a precious treasure for all mankind”.

The interest in astronomy or simply observing the starry sky has always had profound implications for the general conception of the universe in all cultures around the world [31]. Throughout history, humans have looked to the sky to guide their navigation, decide when to plant their crops, and answer questions such as where we came from and how we got here [32]. Human interest in astronomy and the observation of astronomical phenomena date back many centuries [33,34]. This interest in astronomy throughout history has generated a cultural heritage associated with this science through the heritage generated by ancient astronomical knowledge, observations, and interpretations as well as the traditions, myths, and ancient instruments used for these observations [35,36].

Currently, the interest and social curiosity about astronomy and the acquisition of knowledge related to the study of the universe are widespread. The dissemination of this science has been democratised, becoming an attraction for the tourism sector. Astronomy, as a science, and its openness to share its knowledge and experiences with tourists has thus become the basis of emerging tourist activity and a development opportunity for the destinations where this takes place [37]. Astronomical tourism can represent one of the most effective ways to bring tourists closer to nature, helping them to understand the physical world and their environment, promoting education in the field of astronomy, and increasing ecological awareness and the need to minimise light pollution and its negative consequences [38,39]. Findings from several studies suggest that mistimed light exposure disrupts the Circadian rhythm in humans, potentially causing further health impacts [40]. Furthermore, for society in general, it can help to recognise that this type of pollution and its human and environmental consequences are largely unknown [41,42]. The popularisation of astronomy allows us to learn about the benefits associated with scientific and technological advances generated by investments into astronomical research and what their applications could be in the daily lives of the general public [43]. By stimulating curiosity and being used to promote a culture of learning, the populations of astrotourism destinations can acquire a great deal of knowledge about this science [44]. In addition, existing infrastructure that is constantly being updated and modernised can be used for astrotourism and astronomical research at the same time [36].

1.2.2. Institutional Arrangements and Innovations: Astrotourism and Peripheral Territories Sustainability

This type of tourism can also have significant social and economic impacts [44]. Astronomical tourism contributes to the economic sustainability of the destination in which it is developed through the reduction in economic expenditure on energy consumption by regulating the use of artificial light [45]. The arrival of tourists to destinations offering this type of activity, which are usually mainly located in rural, semi-urban, or unindustrialised areas, generates the need to equip these destinations with the infrastructure and services to meet the needs of tourists and complement and improve existing ones, thus benefiting the local population [8]. Astronomical tourism allows both the local population and visitors to

approach the knowledge generated by the dissemination of astronomy and other sciences directly related to it [44]. Stargazing takes place on the outskirts of cities and away from populated areas due to urban growth and increased light pollution. The main astrotourism destinations are in desert areas, high mountains, or sparsely populated regions [9]. The regulation of light pollution is an essential condition for the development of this type of product in direct contact with nature, and the protection of the night sky represents an opportunity for tourism development in various territories [46]. The development of sky protection programs aimed at reducing light pollution has transformed it into a new territorial resource, the starry sky. We can define the starry sky as proposed by [6]: “An immaterial object, seen through a secular mediation between man and the environment. A socio-spatial construction in three dimensions, each referring to a particular visualisation: objective dimension, the visible sky; cultural dimension, the “arterisation” of the sky since the earliest times of mankind; dimension of the phenomenon, the subjectivity of everyone”.

The transformation of the sky into a territorial resource through the reduction in light pollution is a real challenge for the formulation of public policies that involve decision-making at different levels (local, regional, national and international) to reduce this type of pollution without restricting the services to society made possible through the use of artificial light in the absence of sunlight [47–49]. By protecting the sky from light pollution, territories with a low population density, especially those located in rural areas, can offer new tourism products based on the sky that are capable of attracting new tourist flows at all times of the year, without limiting the arrival of tourists strictly to holiday periods [50].

1.2.3. Constellations: Public and Private Strategies

One of the main initiatives in the defence of the recovery of dark skies at an international level, the Starlight Declaration in 2007, also known as the Declaration on the Defence of the Night Sky and the Right to Starlight [45] is: “the generation of new tourism products based on the observation of the firmament and the phenomena of the night, opens up unsuspected possibilities for cooperation between tourism stakeholders, local communities and scientific institutions”. The protection of the sky has provided the public with the possibility of learning about and enjoying the nocturnal landscape, understood as “that landscape of the night that we see every time the sun goes down” [51]. This heritage allows for the creation of experiences related to the conservation, restoration, interpretation, training, and the creation of artistic products [52]. Since the beginning of the 21st century, astrotourism has been experiencing and is motivating a growing interest from international organisations such as UNESCO and the UNWTO for the protection and preservation of the sky, considering it as part of the natural and cultural heritage that must endure over time [2]. This generates clear synergies of sustainable development between a tourist activity and the available resources, thus engaging the socioeconomic and political agents of the territories in which these observations and astronomical tourism practices are carried out. The interest shown in recent decades by international organisations has been reflected in the development of initiatives aimed at regulating light pollution to protect and conserve the night skies and the cultural and natural heritage that surrounds them [9].

To transform a destination into an astrotourism destination, it is necessary to promote partnerships for the development and implementation of action plans that carry out the necessary economic investments for the consolidation of this type of tourism [2]. The regulation of light pollution necessary for the consolidation and improvement in astronomical tourism prevents the local populations of astronomical destinations from being exposed to the negative health impacts generated by this type of pollution [53], in turn helping to preserve the scientific and cultural heritage associated with the astronomical and archaeo-astronomical heritage of the destination [54].

Therefore, the research questions in our study were: (1) RQ1: What are the views of the main social actors and their constellations and interactions? Specifically, (i) the view of the public decision-makers concerning astrotourism and (ii) the perception of civil society involved in the dissemination of astronomy in Aragon? (2) RQ2: What is the institutional

environment concerning the attitudes of the stakeholders towards the sky as a natural and cultural heritage resource that needs to be protected? (iii) RQ3: What is the level of institutional implication (institutional innovation) in this type of tourism?

2. Materials and Methods

A case study was designed using a qualitative approach on one hand (semi-structured interviews with social actors), and an exploratory approach through documentary analysis on the other. These methods help us to understand, in a phenomenological way, the social reality under study [55]. In addition, the thoroughness will have a direct influence on the quality and reliability of the research results [56]. The semi-structured interview allowed us to exercise certain control in the interaction with the interviewee [57,58]. Our role was the key to understanding, in this case, the social innovation and challenges to transform the starry sky into an endogenous and sustainable resource for the tourist development of Aragon [59,60].

The relevant participants in our research were representatives of public and private institutions and organisations in the field of public tourism management and the private sphere of the dissemination of astronomy. As this is an emerging type of tourism, we consider it very relevant to learn the opinions of these types of people, mainly because they are in permanent contact with the host society and with tourists. Moreover, they have an institutional vision and are part of civil society. Twenty-three semi-structured interviews were conducted until the variables under study and the identified categories into which the information to be analysed was grouped were saturated, at which point, the participation of a larger number of informants no longer provides additional information [61,62]. Relevant informants came from all throughout the region (see Table 1 and Figure 2).

Table 1. Relevant informants.

Number of Informant	Type of Informant
Tourism Technicians in Public entities	
IRDT No 1	Tourism technician Comarca Gúdar—Javalambre (Javalambre, Teruel)
IRDT No 2	Head of Tourism Office of the Municipality of Gúdar (Gudar, Teruel)
IRDT No 3	Head of Tourism Foundation for the Development of Huesca (Huesca, Aragon)
IRDT No 4	Tourism Technician of Albarracín Region (Albarracín, Teruel)
IRDT No 6	Responsible for the Tourist Office of the Municipality of Puertomingalvo (Teruel)
IRDT No 7	Responsible for Tourism Directorate General of Aragon (Zaragoza)
IRDT No 9	Head of Tourism Office of the Municipality of Manzanera (Manzanera, Teruel)
IRDT No 10	Head of General Directorate of Tourism, Aragón (Zaragoza, Aragon)
IRDT No 11	Head of Tourism Office of the Municipality of Alcalá de la Selva (Teruel)
IRDT No 15	Responsible for the Astronomical Observatory of Montalbán (Montalbán, Teruel)
IRDT No 16	Responsible for the Astronomical Observatory of Torres del Alcanadre (Huesca)
IRDT No 17	Head of the Aragonese Astronomical Centre (Huesca, Huesca)
Political representatives of the three different Aragonese locations where Starlight has been certified	
IRDT No. 5	Councillor for Tourism, Montalbán Town Council (Montalbán, Teruel)
IRDT No. 2	Mayor of Aliaga Town Council (Aliaga, Teruel)
IRDT No. 8	Mayor of Gúdar Town Council (Gúdar, Teruel)
Civil society: Representatives of astronomical associations and private businesses in Aragon	
IRDT No. 13	IRDA No. 13: Head of the Astronomical Association of Teruel (Teruel, Teruel)
IRDT No. 14	IRDA No. 14: Head of the Astronomical Association of Monzón (Monzón)
IRDT No. 18	IRDA No. 18: Head of the Astronomical Association of Sabiñanigo (Sabiñanigo, Huesca)
IRDT No. 19	IRDA No. 19: Head of the Astronomical Association of Zaragoza (Zaragoza)
IRDT No. 20	IRDA No. 20: Head of the Astronomical Association of Monegros (Sariñena)
IRDT No. 21	IRDA No. 21: Head of the Astronomical Association of Somontano (Barbastro)
IRDT No. 22	IRDA No. 22: Manager of the Astronomical Association of Huesca (Huesca)
IRDT No. 23	IRDA No. 23: Manager of the Silos Astronomical Group (Zaragoza)
IRDT No. 12	IRDA No. 12: Manager of Aliaga Hostel (Aliaga, Teruel)

Source: Prepared by the authors, 2022.



Figure 2. Identification of geographical origin of the relevant informants from the Region of Aragon, as prepared by the authors, 2022.

3. Results

To analyse the information collected in the semi-structured interviews, we worked with the discourse once the transcription had been carried out. Therefore, in order to analyse the information gathered in the interviews, we first transcribed the audio generated in each of them, reflecting all the fundamental aspects for their understanding. We were interested in understanding the meanings that underlie discursive productions in order to inductively obtain the impacts and possibilities of astrotourism in Aragon [63]. The data

obtained were analysed by applying the methodology of the “affinity diagram” (method-KJ or Team Kawakita Jiro, TKJ). This methodology was developed by the anthropologist Jiro Kawakita to gather the opinions and ideas that are in a state of disorganisation into categories, helping to group the elements that are naturally related and associating the many verbal data by subject, facilitating the identification of the most important situations under some key ideas [64]. The method uses a bottom-up approach to generate order from chaos; the method requires that the data be viewed outside of any existing concept or framework; the method prioritises feelings over reason; and at the conceptual level, the method is consistent with the essence of creativity [65].

Codes, categories, and themes were based on the research objectives: (i) descriptions; (ii) interpretations; (iii) inductions; and (iv) deductions. The main ones that were identified are presented in Table 2, and came from the interview script used in this research, which appears in the Supplementary Materials, and its analysis through teamwork.

Table 2. The main codes, categories, and topics.

Descriptive Codes	Inductive Codes	Categories
Important territorial resources	Forced migration	Astrotourism Depopulation Positive social impacts Negative social impacts Positive environmental impacts Negative environmental impacts Training Territorial illusion Resilience Social innovation Institutional innovation Partnership Cooperation Environmental challenges Sustainability Tourist experiences Destination as a concept Emotional experiences Natural resources Dark sky Cultural heritage Laws Public policies of development Endogenous development
Sky as a natural resource	Forgotten territories	
Out of the beaten tracks	Difficulties of survival	
Natural resources	Hope	
Cultural resources	Astrotourism as a new resource	
Associationism	Search for solutions	
Astrotourism products	Strength of Associations, highlights the	
Educational products	Gúdar-Javalambre tourism association	
Complementary offer to other types of tourism	Entrepreneurship	
Aragon as a potential astrotourism destination	Training	
Teruel, a driving force in astrotourism	Enthusiasm	
Centre for the Practice and Dissemination of Astronomy	Political failures of real planning for this type of tourism.	
“Galactica” in Arcos de las Salinas	Institutional importance at local level	
Interpretative codes	Deductive codes	
Despair feeling	Training opportunities	
Forgotten places	Supply of high quality astrotourism products	
Fear of depopulation	Shortage of services	
Astronomical interest	Deseasonalisation of demand	
Positive feelings towards sky	Complement to other tourism products	
Astrotourism as behaviour mobilising	Economic recovery	
Socio-economic achievements	New institutional strategies	
Fear of losing achievements	Regulation of public lighting	
Social arrangements	Rules for the use of light	
Institutional arrangements	Public environmental policies	
Development policies		

Source: Prepared by the authors, 2022.

The steps that were followed to process the information obtained from the interviews were as follows: (1) group the information obtained from each type of interview into topics, categories, and codes; (2) analyse the information corresponding to each category reaching theoretical concepts illustrated by the speeches of the relevant informants interviewed; and (3) elaborate an affinity diagram with the said results. The information obtained in the speeches was grouped into categories identified based on the research objectives and then grouped again into different emerging topics: (1) off the beaten track and the absence of light pollution, the paradox; (2) the sustainable social and territorial development; (3) vital

experiential astrotourist products; (4) institutional innovation in Aragon; (5) emerging social innovation and needs; (6) socioeconomic impacts; (7) norms and legal proposals; and (8) the image: international sky quality certifications.

3.1. *Off the Beaten Track and the Absence of Light Pollution, the Paradox*

This type of tourism is intrinsically linked to the absence of light pollution and shines even brighter, to use the metaphor, thanks to depopulation and certain characteristics of the Aragonese territories. As one of the relevant informants said: “Astrotourism is presented as a great opportunity for Aragon, turning a weakness of our region such as depopulation, which facilitates the existence of clean skies without light pollution, in an opportunity” (IRDT No. 7). The consequence that most informants affirmed is that this circumstance can transform forgotten places into reference destinations for this type of tourism. Moreover, astrotourism then becomes a tool to give a voice to the territories known as “empty Spain”, opening a path to endogenous and sustainable socio-economic development, as has also been demonstrated in other territories [66,67]. As IRDT No.8 said: “It is an innovation in the world of tourism that places the interior of Spain, such as the province of Teruel at the forefront; astrotourism can help forgotten territories, from the so-called empty Spain to be leaders at the level of tourism” (IRDT No. 8).

Our informants point out that the astrotourist has, in general, a high socio-educational level and approaches nature with a different, more environmentalist outlook and with a greater awareness of their activities in the area. One of the informants said that: “Moreover, this type of tourism, which helps to deseasonalise, serves to complement tourism demand and complements other types of tourism such as cultural tourism, nature tourism, family tourism, sports tourism, those looking to eat well, etc. And above all it is interesting because it can be considered scientific tourism and this can attract a public that respects the environment and therefore has a high-cultural level and medium-high purchasing power” (IRDT No. 3). Another stated: “Astrotourism responds to the demands of an increasingly informed tourist looking for exciting experiences” (IRDT No. 9).

However, it is important to recognise an emerging paradox when these territories develop endogenously and lose their initial characteristics, acquiring a new territorial status that strips them of their original value, a graphical representation of this is shown in Figure 3 below.

3.2. *The Sustainable Social and Territorial Development*

The social and territorial development paradox is one of the most important consequences of astrotourism observed by our informants. As one of them said: “I believe that all the initiatives that are developed through the use of the sky are beneficial for the rural areas, the experience we have is very gratifying, we are succeeding, and more and more people are coming” (IRDT No. 5).

The reasons given consider that the integration of the starry sky as an endogenous territorial resource generates a level of concern for its preservation. In addition, it triggers self-esteem in the local population, opens up possibilities for youth entrepreneurship, and restores the hope of the elderly. Some experiences are already consolidated such as the “Lágrimas de San Lorenzo” in Huesca (one of the three capitals of the three provinces in the Aragonese region) or “The Messier Marathon” in Monzón (Huesca), another small village in Aragon.

“Astrotourism is a type of sustainable tourism, which does not harm the environment (. . .). I would agree that its development be promoted at the institutional level, thereby helping to raise awareness about respect for the environment and the regulation of light pollution. It should be promoted not only at the institutional level but also through the industry and by the Aragonese themselves. We should be interested in taking advantage of the sky that we have by making people aware of the interest that the starry sky arouses . . . ”. (IRDT No. 7)

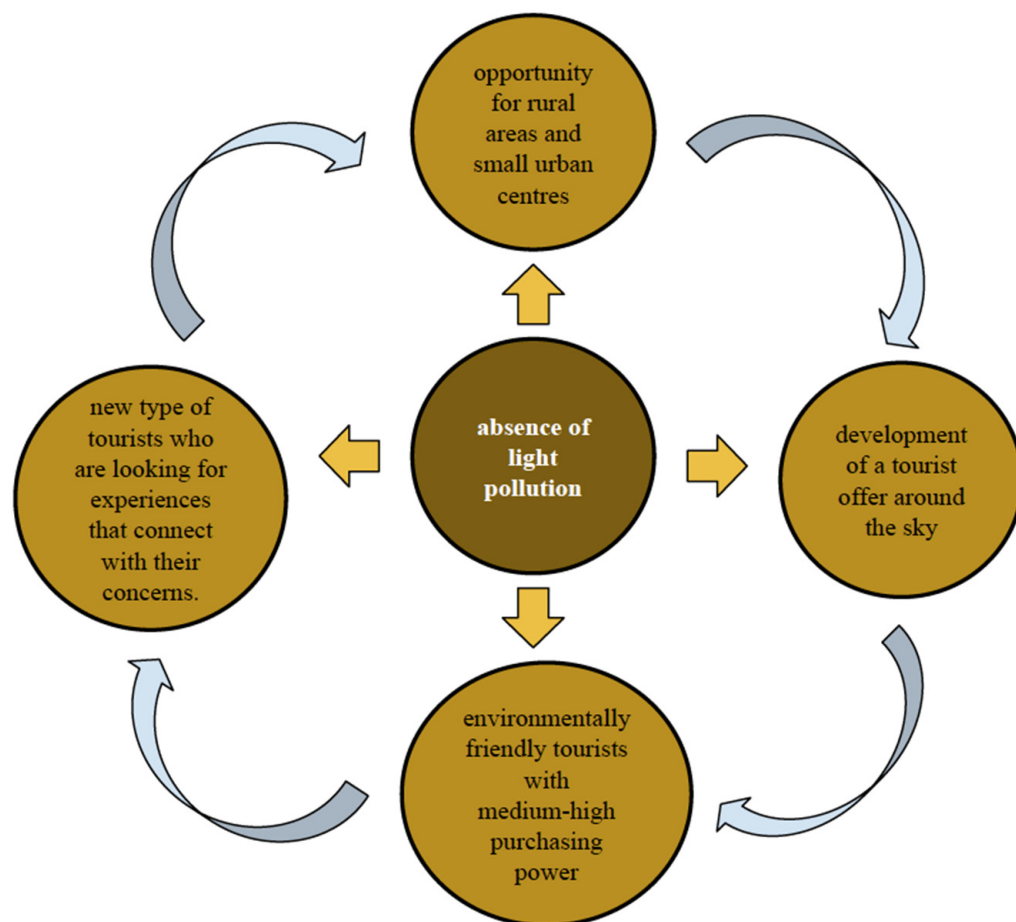


Figure 3. Opinions on this emerging type of tourism, prepared by the authors, 2022.

3.3. Vital Experiential Astrotourism Products

Most of the tourist products that make up the astrotourism offers are developed during the night; this generates magical and mysterious experiences, surrounded by different emotions. This means that they are complementary products that enrich the daytime offers. Our informants are aware of this and have high hopes for these types of astrotourism products given the territorial ease of creating, designing, and offering them. As this informant said: “The motivations for traveling are increasingly varied and diverse, sometimes it is difficult for a tourist to travel alone to carry out an activity. Tourists usually complement their trip by looking for complementary products. In Aragon we currently have good tourism products, but we also have to look for activities that are part of an additional offer such as astrotourism. Virtuous feedback can be generated with the rest of tourism products” (IRDT No. 10). Following this, the informant also said: “Astrotourism fits in with the new trends of tourists who are looking for experiences that connect with their concerns and interests. Astrotourism fits in with the new tourist tastes” (IRDT No. 10).

3.4. Institutional Innovation in Aragon

3.4.1. Public Sphere Strategy

Thanks to a commitment to participation and institutional innovation, the Regional Government of Aragon has taken the initiative to include astrotourism within the PAET 2016–2020 tourism excellence plan (Gobierno de Aragón, 2021). However, the different Aragonese entities that have participated in this strategy demand a greater involvement of the regional government. More specifically, they request a roadmap that allows them to achieve certain objectives regarding the strengthening and improvement in this type of tourism. The informants denounce the slowness with which the strategic planning

of astrotourism is facing and emphasise that the counties and municipalities should be responsible for promoting it.

“The Government of Aragon has shown interest but in my opinion the support provided is not enough, I think it does not have a concrete plan on how to develop this type of tourism in our region (. . .). However, some rural areas and municipalities do have an interest because they see in astrotourism the differentiating element they need to generate some tourist movement” (IRDT No. 1). Figure 4 is based on the speeches of the relevant informants we interviewed and data from the documentary analysis.

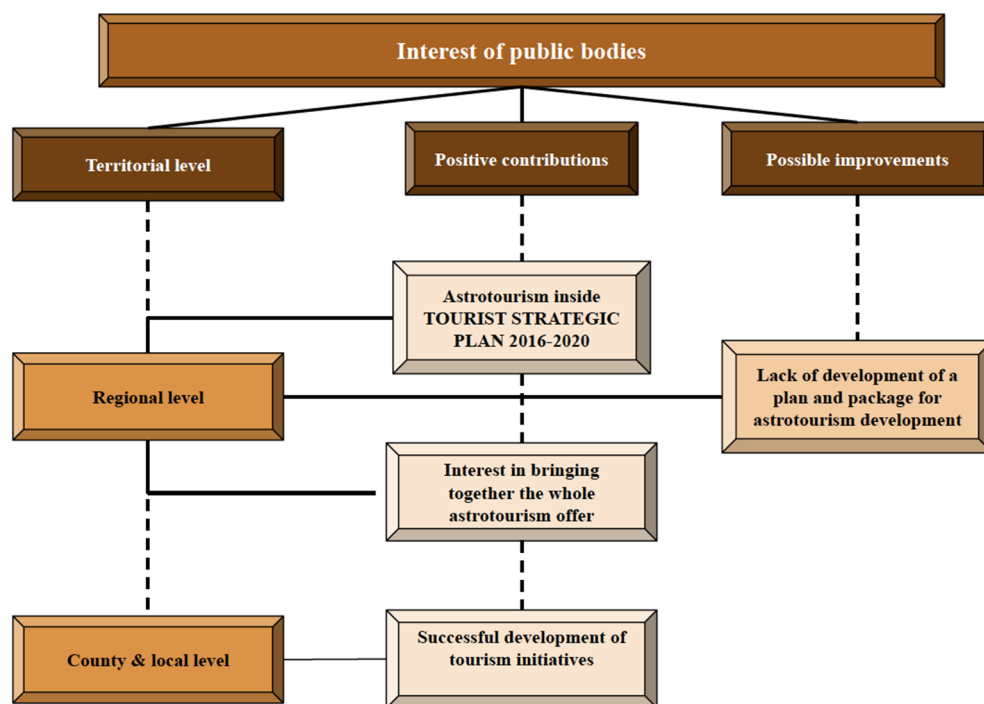


Figure 4. Interest of public bodies in the development of astrotourism, prepared by the authors, 2022.

3.4.2. Interest in the Private Sphere

The private sector is also interested in including astrotourism activities within their offering and intend on participating in training proposals to be better fit for this type of tourism. The Aragonese municipalities and counties in which the development of astronomical tourism is being developed have expressed their interest in joining with both the public and private sectors. Thus, local companies have joined in the efforts to participate in both the knowledge of this type of tourism and tourists, and in the enhancement of the sky as a resource.

“There is great interest from private entrepreneurs, but it is difficult for their initiatives to develop if there is no coordination and support from public entities (. . .). It must be a joint work from public entities and companies, there has to be total collaboration”. (IRDT No. 4)

3.5. Emerging Social Innovation and Needs

Many of our informants belonged to astronomical associations that have been established in the territory for many years. Their main task has been to promote the study and research into astronomy. Over the last ten years, they have also played a singular role in the dissemination of this science and the promotion of astrotourism. Precisely, the innovation lies in the interest in democratising a science that has for a long time remained exclusively for the elite and how groups focused on astronomy are now emerging from civil society as well as the important social movement of small entrepreneurs who wish to promote dark

sky certifications at the international level, being aware of the importance of all of this for the territory.

In order to achieve the social skills desired by the informants, they were aware that at least three elements needed to be achieved in Aragon: (a) training aimed at those interested in acquiring knowledge about this type of tourism to be able to offer a quality service to tourists who sought to participate in this type of experience; (b) investment and subsidies to be able to adapt places that potentially have astronomical resources with the necessary infrastructure to be able to carry out activities related to the dissemination of astronomy as well as promote subsidies for the development of youth entrepreneurship in relation to this type of tourist products; and (c) enact the relevant legislation required for the preservation of the night sky, regulating the use of artificial light in the surroundings of the destinations that support this type of tourism, but at the same time considering the needs of the local population.

“From the public sphere, the first thing to do is equip destinations with the necessary infrastructures (. . .), The necessary initiatives to contribute to the development of astrotourism in Aragon must start from investment in infrastructures and be aimed at training to provide a quality service, in the field of light pollution. Although we do not suffer in Aragon from a serious problem of light pollution, it is necessary to legislate specially to avoid this type of pollution close to the destinations where night observations are made. As for the subsidies, they exist at present but perhaps they should be oriented towards youth entrepreneurship and also astrotourism, but there must also be business risk” (IRDT No. 10). From the interviews, Figure 5 shows the necessary initiatives for the development of astrotourism in Aragon.

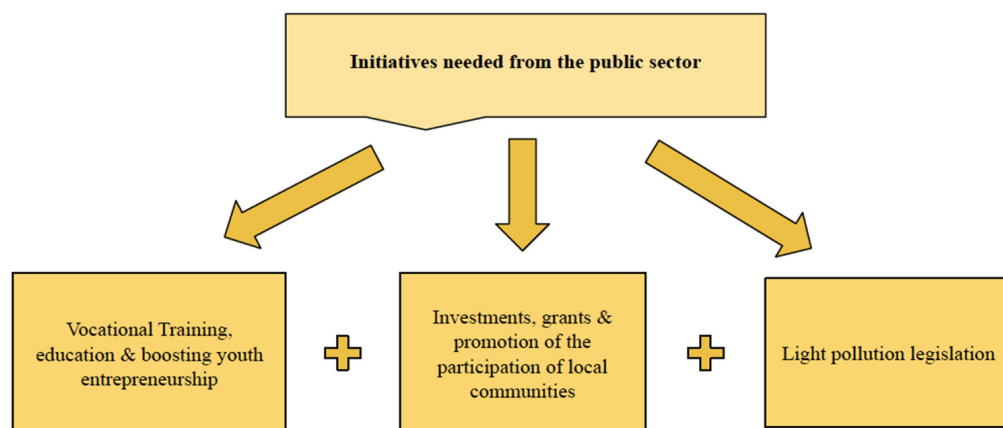


Figure 5. The necessary initiatives for the development of astrotourism, prepared by the authors, 2022.

3.6. Socio-Economic Impacts

For all of those interviewed, the socio-economic impacts generated by astrotourism in the destinations where it takes place in Aragon, located in most cases in rural areas, were mostly produced by the expenditure incurred by the astrotourists in situ. This expenditure is generated through the consumption of both the astrotourism product itself and other services during the tourist's stay in the community. This consumption works as a chain, which allows income from tourists to flow into the destination, generating both direct and indirect jobs, in turn helping the local accommodation and businesses to supplement their income at times of the year when demand is lower and attract investment to improve and/or equip them with new infrastructure. This is an aspect to consider given that the improvements can be used by both tourists and the local population. The impacts generated by astrotourism represent an opportunity for the local population to continue to live in their municipalities and not have to emigrate to other parts of Aragon or further, in search of greater opportunities. Figure 6 shows the impacts of astrotourism in Aragon the impacts of astrotourism in Aragon, based on the analysis of the discourses of the interviewees,

which also coincide with many of the existing theories and literature on astrotourism in other regions around the world.

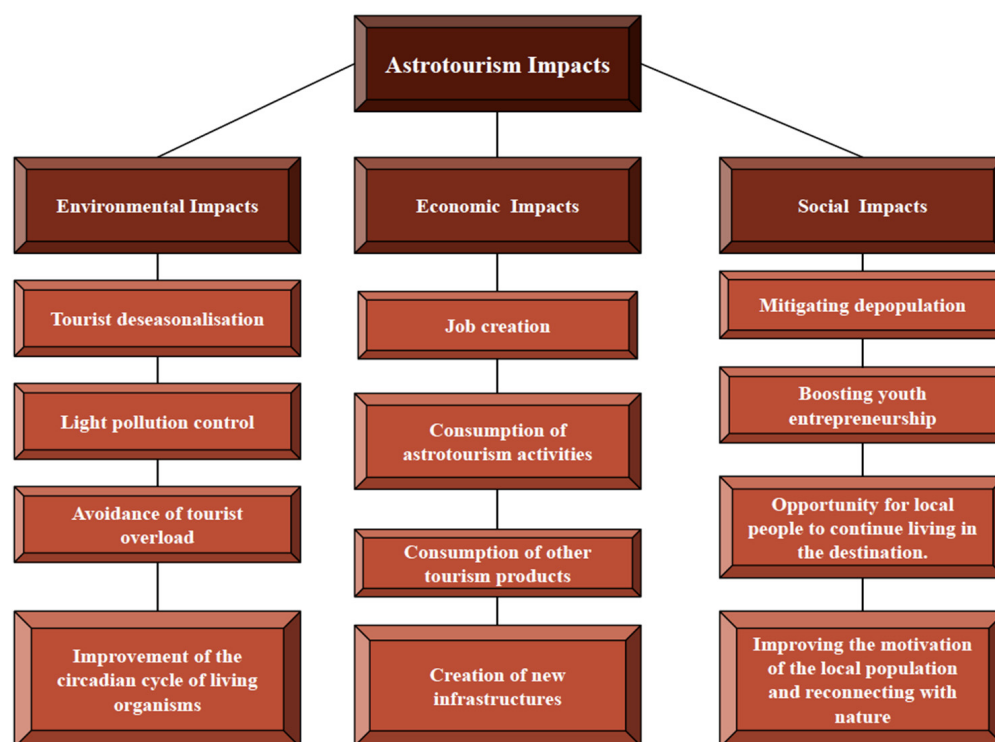


Figure 6. The socio-economic impacts of astrotourism in Aragon, prepared by the authors, 2022.

“The tourist who comes to observe stars tends in most cases to overnight in the chosen destination, implying this fact an expense in accommodation and other services such as food or spending in local shops. This is a matter that affects especially the economic development of the destinations that are committed to this type of tourism (...). It is an opportunity not only for the service sector, but it can be a professional opportunity for young people willing to be trained to become astrotourist guides (...). These young people who would otherwise see no future in their municipality can find a way to stay in their rural communities instead of transferring to urban areas”. (IRDT No. 7)

“When tourists arrive at a given rural destination, they contribute to the generation of impacts through the income they leave behind. It is a chain: jobs are generated, infrastructures are improved and in the case of astrotourism, although it is still a bit early, since it can be offered all year round, it can help to establish new population centres in the municipalities that are committed to this type of tourism”. (IRDT No. 6)

3.7. Norms and Legal Proposals

Aragon, due to various factors such as depopulation and the distribution of the population, enjoys a great sky quality in most of its territory, concentrating light pollution in urban centres. Currently, there is no legislation that regulates this type of pollution, and for this reason, if the objective is to offer sky quality throughout the Aragonese territory and enhance the development of this type of tourism within the municipalities (even if they are in rural areas), legislation must be enacted to prevent the causes that generate this type of pollution from occurring. As most of the informants indicated, it is the municipalities themselves that have taken the initiative regarding the control of light pollution at night

while awaiting legislation in this regard. However, a certain level of reluctance was noticed when it came to the elderly, who fear nocturnal light control as a risk, mainly.

“In the municipalities that back the astronomical tourism, the legislation must be adapted to the needs of this type of tourism. Regions such as the Canary Islands and Andalusia can serve as an example in this type of lighting reforms”. (IRDT No. 1)

“What I’m seeing is that the municipalities that are concerned about developing astrotourism are doing their part so that the lighting is compatible with this activity, such as lowering the intensity close to the places where observations are made. For the moment being, this is done on a voluntary basis, but it would be necessary to modify the legislation and make everyone aware of the potential of this type of tourism”. (IRDT No. 5)

3.8. *The Image: International Sky Quality Certifications*

One of the tools to promote and value the quality of the Aragonese sky is to obtain quality certifications for the night sky. Through obtaining these types of sky quality certifications, the destination becomes known to astrotourists as it relates to the image of quality and professionalism in the development of this type of tourism. This type of tourism attracts astrotourists of different levels during all seasons of the year. The province of Teruel has taken the initiative in relation to this type of certification by obtaining the only quality certifications that currently exist in Aragon. These places are positioning themselves as astrotourism benchmarks worldwide, attracting astronomical tourists who prioritise the guarantee of starry skies that these international certifications provide.

“This type of certifications serve to make you visible, so that tourists can place you on the map, especially by means of obtaining a certification we make ourselves known to both astronomy fans and experts in this field. They know that we are here and that we have favourable conditions (...), the certifications can help astrotourists to come from different countries, even from outside Spain”. (IRDT No. 7)

“They always add up, they are a recognition of the quality of the starry sky, above all they attract more specialised, more technical tourists. Certifications help to differentiate a territory from the others” (IRDT No. 1). Considering all the opinions of the relevant informants in relation to astrotourism in Aragon, in addition to the structure of the analysis carried out and the reference theories, we have built the so-called affinity, which can be seen in Figure 7. The sky, as a natural resource, impacts on public and private initiatives. These are characterised by the development of different products, experiences, and bets, consolidating the supply of astrotourism products that generate impacts on the territory.

All of this, in turn, provokes a greater commitment on the part of the autonomous government into these type of offers as well as a growing interest on the part of entrepreneurs and the private sector, in general, which seeks greater training and information to offer quality astrotourism products and services.

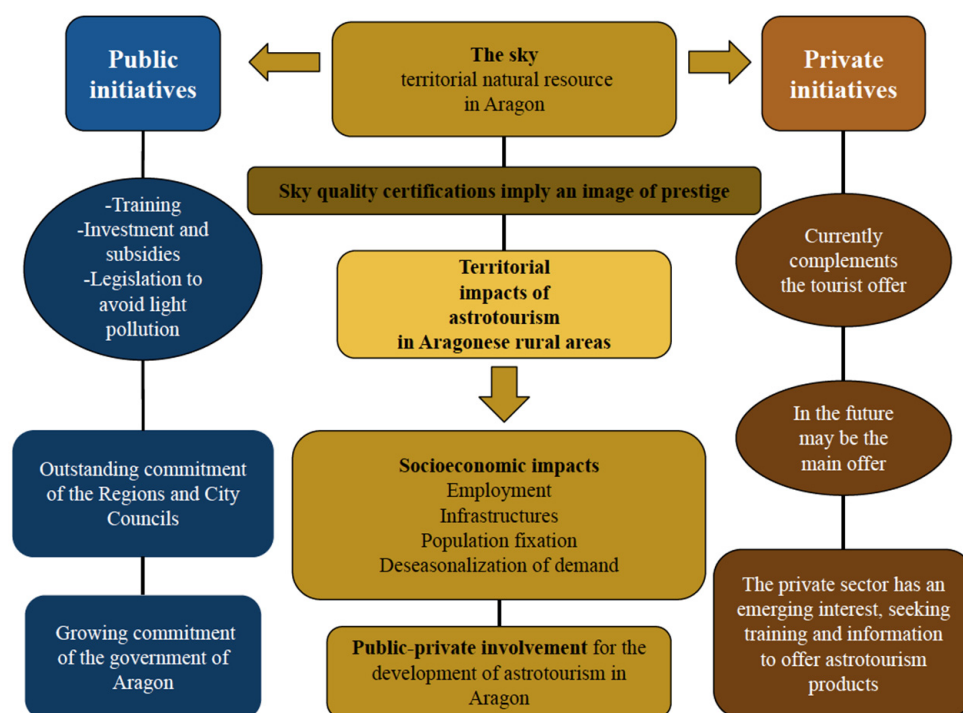


Figure 7. Affinity diagram, prepared by the authors, 2022.

4. Discussion

Similar to Fayos-Solá, Marín, and Jafari (2014) [38], our research reached the conclusion that astrotourism is a way of creating sustainable destinations in peripheral territories that satisfies the social needs of being in nature and ensures that the light pollution of the territory is controlled. In our research, it was highlighted that astrotourism is a new medium in conceptualising a tourism destination image by combining destination Earth features as well as sky features. Our informants revealed this, which coincides with the research carried out by Soleimani et al. (2019) [4]. Likewise, we also agree with Soleimani et al. (2019) [4] that combining the characteristics of the sky with adequate observation facilities would attract tourists by offering unique tourism products. Astrotourism generates social capacities compatible with the development of tourism products at night and are developed by young people with astronomical concerns, which is also in agreement with the dissertation by Gerasimova (2021) [68]. Young people in localities where astrotourism is developed enter the world of entrepreneurship and knowledge, which leads to the settlement of the population and comprehensive social improvement, coinciding with previous research by Sanagustín-Fons, Lafita-Cortés, and Moseñe (2018) [64].

Tourism, and more specifically, astrotourism, generates certain social capacities in rural territories, which was corroborated in our research and coincides with the doctoral thesis by van Wyk-Jacobs (2018) [69]. The reasons are diverse, mainly in the sense that (i) it seasonally adjusts the demand and promotes the generation of youth entrepreneurship, associations, and even collaborative economy products (Sanagustín-Fons, et al., 2018) [64]; (ii) generates employment; (iii) settles the population; (iv) generates an observed self-esteem in the local population [11]; and (v) increases the value of the historical cultural and natural heritage resources (Sanagustín-Fons, Moseñe-Fierro, and Gómez-Patiño (2011)). [70]. In addition, our informants observed a growth in the demand and motivations of tourists in relation to astrotourism. Our research differed to that carried out by Cater (2010) [71], since in rural areas, only the observation of the night sky and the democratisation of astronomical knowledge and not the trip to space that remains for different territories including a more elitist approach.

Our research coincides with that of Cater (2010) [72] in relation to the importance of the sky and the possibility of its observation in sparsely populated rural areas. Furthermore, these authors affirm that the dominant dry climate as well as the infrastructure available and accessibility to observatories (scientific or otherwise) has given way to the expansion of astronomical tourism in several locations. This also coincides with the research by Soltanolkotabi (2017) [73] on the enormous potential that astrotourism has in Spain. Likewise, Kanianska, Škvareninová, and Kaniansky (2020) [74] state that dark sky phenomena can be observed more easily in places where light pollution is lower.

In our research, there were some differences to that of Weaver (2011) [75], as no evident collaboration between ecotourism organisations and astronomy-related institutions promoting “dark sky” reserves was found. There is still much to do in destinations such as Aragon, mainly because the astronomical phenomena are not adequately disclosed, nor are they known to the public or, on occasion, not even to the local population.

Our study is consistent with the point of view of the tourist offers of an area, the starry sky generates new tourist products, strengthening the already existing tourist offer by integrating the sky as another territorial resource [76]. This fact generates an opportunity for astrotourism through the inclusion of the starry sky as a resource within territorial development programs and policies [76]. Therefore, turning the sky free of light pollution into an extra source of income, employment generation, and socio-economic development [49]. A starry sky, free of light pollution, also known as a “dark sky” [77], can become a territorial tourism resource [7]; however, we observed a kind of paradox in relation to the dark sky and all of its considerations. The sky becomes an engine for the sustainable and endogenous development of local communities in which this emerging type of tourism is developed [2,44], however, sometimes the locals fear losing some recent achievements such as artificial street lighting at night, among others. The study by [78] considers that it is necessary to evaluate whether lights on poles are the best way to light a city or an area. In our research, the narratives showed that local communities also doubt whether a natural resource such as the sky can become a tourism resource in its own right, which has not been considered in other research [2,74,77].

The environmental impacts generated by astrotourism in the destination are directly related to the regulation of light pollution. Efficient use of artificial light leads to a reduction in CO₂ emissions. Astrotourism acts as the perfect ally to recover natural heritage associated with the night sky, whose observation is being deprived to the populations of more than 85% of the population in Europe [79,80]. As we have seen in this research, the misuse of artificial light not only causes negative effects on human health, but these negative effects are also spreading, harming animals and plants. Finally, the results of our research corroborate the definition of astrotourism (Starlight Foundation, 2021) [45]. Specifically, it coincides in considering it as a form of sustainable and responsible tourism that combines night sky observation, dissemination, and leisure activities related to astronomy. However, it is also a resource to promote territories with fewer possibilities that find in astrotourism an excellent opportunity to increase unique and different visitors.

5. Conclusions

The new institutionalism in sociology based on the actors provides a coherent explanation of some of the most relevant aspects in the analysis of astrotourism in Aragon, a territory in which rural areas predominate, with a very low population density. This fact generates the existence of large areas of territory with skies free of light pollution. This type of tourism is becoming one of the most powerful emerging and original tourist experiences in Aragon. Astrotourism is an opportunity for the endogenous and sustainable socioeconomic development of these called forgotten areas. It places the sky as a natural resource around which public policies are carried out. Nevertheless, the so-called light pollution paradox emerged, where some locals felt that the control/regulation and possible reduction in artificial light in their villages was a security risk for them. However, at the same time, the emergence of social innovation processes through the awareness of

the regulation of artificial light and the positive impact of the practice of astrotourism in Aragon was verified.

Therefore, we can conclude that social and institutional innovation is reinforced in Aragon mainly due to the lack of light pollution regulation to avoid any disruption to the astronomical observations. This fact leads to the promotion of association and cooperation among the local population working with close institutions. This cooperation is supported by those institutions oriented towards obtaining international quality certifications from the sky. These certifications of the starry sky show the commitment of a part of the territory to the preservation of the dark sky. This study also showed the emergence of some institutional innovation aimed at regulating artificial light and the dual use of facilities and infrastructures to disseminate astronomy and bring related sciences such as physics, mathematics, and others to the public, both the host society and tourists, and by also taking advantage of the infrastructure that can be used for both social and scientific uses. The socio-economic impacts of astrotourism in Aragon are mainly determined by two variables: (i) the expenditure of tourists in the destinations and (ii), the investment in infrastructure and services that will allow for the arrival of astrotourists throughout the year. Astrotourism can move away from the mass tourism offers and fits in with the new trend of tourists looking for experiences that connect with their concerns and interests, thus attracting new segments of the population such as seniors, young people, or families.

In order to transform a natural resource such as the sky into a tourist product, a set of investments is necessary. These investments should contribute to the promotion and development of companies that offer astrotourism experiences. Figure 8 shows the public policies necessary for the development of astrotourism in Aragon.

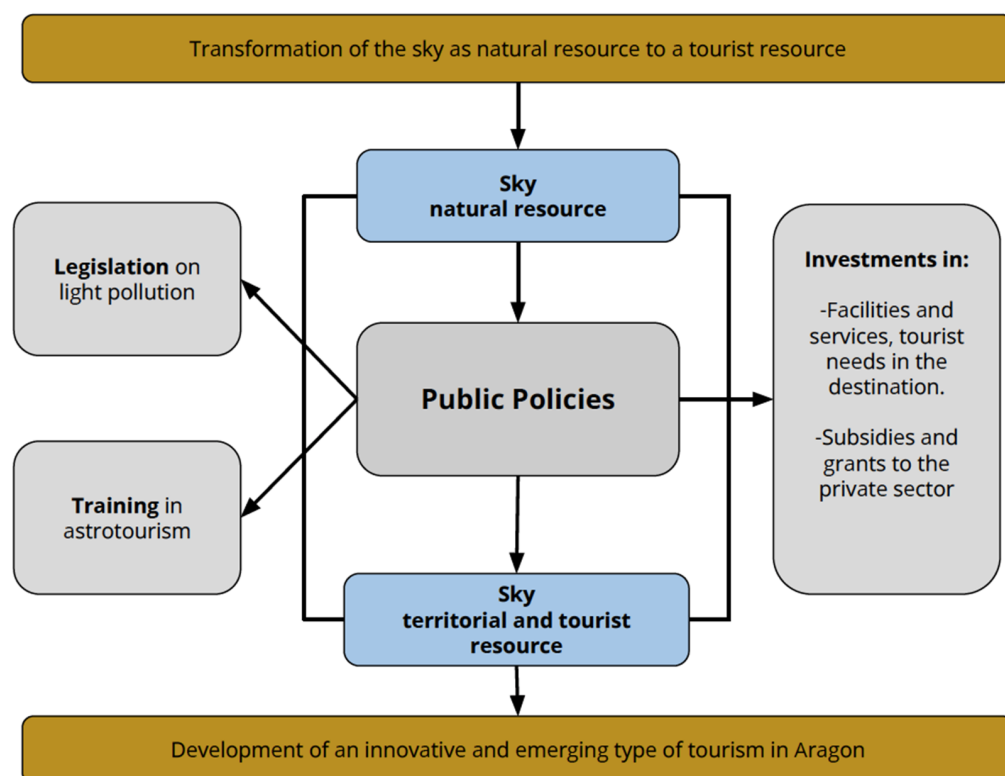


Figure 8. The public policies to transform the sky into a tourist resource, prepared by the authors, 2022.

The future lines of research that we wish to open in relation to this specific type of tourism aim to analyse the opinions and perceptions held by two of its main actors: (i) the local population and (ii) tourists; precisely, the deepening in both social groups is presented, at the same time, as the main limitations of this research, but open up hope to little known tourist destinations such as this region of inland Spain known as Aragon.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su14116419/s1>, the Semi-Structured Interview Script is available online.

Author Contributions: Conceptualisation, F.E.-S. and V.S.-F.; Methodology, F.E.-S. and V.S.-F.; Validation, C.Á.-A., F.E.-S. and J.A.M.-F.; Formal analysis, F.E.-S. and V.S.-F.; Investigation, V.S.-F. and F.E.-S.; Data curation, J.A.M.-F.; Writing—original draft preparation, C.Á.-A. and J.A.M.-F.; Writing—review and editing, F.E.-S. and V.S.-F.; Supervision, V.S.-F. All authors have read and agreed to the published version of the manuscript.

Funding: This study was co-financed by the Regional Government of Aragón in the framework of the Research Group Ref. S33_17R. Also, project PID2019-107822RB-I00 funded by MCIN/ AEI /10.13039/501100011033.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data from the interviews can be found in their own database.

Acknowledgments: We wish to acknowledge all the people who participated in the interviews in the region of Aragon (Spain). Thanks to them, this research was developed. We would also like to acknowledge the institutional support received from the University of Zaragoza.

Conflicts of Interest: The authors declare no conflict of interest.

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