ECOSYSTEM COLLABORATION FOR CLIMATE ACTION: A CASE STUDY OF THE ILCA PROJECT

Ancuța Agheniței[1*], Carmen Nastase[2], Carmen Chașovschi[3]

[1]Ștefan cel Mare University, Suceava, Romania, ancuta.lucaci@usm.ro
[2]Ștefan cel Mare University, Suceava, Romania, carmen.nastase@usm.ro
[3]Ștefan cel Mare University, Suceava, Romania, carmen.chasovschi@usm.ro

Abstract
In recent years, the number of initiatives dealing with climate change has increased significantly as human activity releases more and more greenhouse gases into the environment. There is no doubt that the effects of these emissions are numerous and increasingly alarming. Against this background, this paper assumes that climate change requires the engagement of various groups of stakeholders. This engagement is referred to in this paper as ecosystem cooperation for climate action. A feature of ecosystem cooperation is the potential to create a multi-stakeholder network of new partnerships that can generate innovative solutions to climate change problems. This paper argues that ecosystem collaboration is particularly important for both preventing and responding to climate change. Following a theoretical explanation of the concept of ecosystem collaboration, a case study on climate change and sustainability is presented. This case study highlights best practise examples within a European project entitled "Innovation Laboratories for Climate Actions" (ILCA). Through a consortium of six universities and three research institutes from different European countries, the ILCA project aimed to engage multiple stakeholders in national, regional and local ecosystems to develop innovative solutions to tackle climate change. The project brought together businesses, public administrations, civil society and academia from each country. The findings of this paper emphasise the importance of the ILCA project in tackling climate change through ecosystem collaboration and the establishment of a 'Climate Innovation Lab' at the Stefan cel Mare" University in Suceava. Such a lab brings together experts from different fields such as economics, engineering and medicine to find innovative solutions to climate problems. We also emphasise the active role of innovation in helping tourism businesses to adapt to climate change. Innovation and collaboration are crucial to fostering a cooperative environment in relation to climate change mitigation.

Keywords: ecosystem collaboration, climate change, European project, climate innovation laboratory, tourism business

JEL Classification: D70, O32, Q54, Z32

DOI: 10.24818/CTS/6/2024/2.06

1. Introduction

According to the United Nations (2024a), climate change refers to the long-term development of atmospheric conditions that causes a continuous rise in temperatures around the world. The extent of climate change largely depends on the amount of greenhouse gases released into the atmosphere by human activities. Sectors such as industry, transport, agriculture and deforestation generate large amounts of greenhouse gases in the atmosphere. A recent study published on the Climate Change Knowledge Portal (n.d.) of the World Bank Group (WBG) emphasises that we could reduce the global annual temperature by 2 degrees Celsius. To achieve this, economies around the world should reduce the amount of greenhouse gases emitted into the atmosphere. However, achieving an overall reduction in greenhouse gase will require the cooperation of many stakeholders.

* Contact author
Authors' ORCID:
Agheniței Ancuța
Nastase Carmen
Chașovschi Carmen

The literature describes numerous impacts of climate change, particularly greenhouse gas emissions, on the environment, the economy and people. Jacob and Winner (2009), for example, argue that higher temperatures, wind patterns and wildfires caused by climate change have an impact on air quality, particularly in some of the most polluted regions of the world. In their article on climate change, Amin et al. (2014) found that the effects of climate change have negative consequences for agricultural crops. Schulte et al. (2016) examined the link between climate change and occupational safety and health and emphasised the need for effective risk management to address and adapt to climate change.

We are currently witnessing a growing number of interesting projects focussed on finding solutions to the challenges faced by individuals, businesses and policy makers. Ecosystem collaboration plays an important role in these projects as it connects key stakeholders with economic, political, technological and social knowledge to initiate action against climate change. The organisation of the COP28 conference in Dubai in 2023 is a best practise in the field of climate change (COP28 UAE, n.d.; United Nations, 2024b). This initiative has brought together several categories of stakeholders such as start-ups, innovators, entrepreneurs, business accelerators, non-governmental organisations, policy makers and academics. Discussions during the conference revealed that progress in tackling climate change, including greenhouse gases and resilience, is insufficient globally. Therefore, this event proposes that countries should reduce their greenhouse gas emissions into the atmosphere and initiate a transition to a green economy.

In view of the fact that countries will have to become climate neutral in the future, we believe that cooperation between ecosystems is a solution for combating and adapting to climate change. The aim of this article is therefore to emphasise the importance of ecosystem collaboration for climate action by presenting the ILCA project as a model of best practise in Romania. “Innovation Laboratories for Climate Actions” (ILCA) is a European project funded by the European Institute of Innovation and Technology that aims to tackle climate change through research, education, innovation and sustainability (Innovation Laboratories for Climate Actions – ILCA Project, n.d.). This project was implemented over a two-year period, starting in 2022 and ending in 2024. It also emphasises the active role of academic institutions in connecting different stakeholders to combat climate change. The ILCA project has carried out numerous activities in the field of climate change by creating a sustainable ecosystem within the “Stefan cel Mare” University of Suceava, Romania.

The article is divided into several parts. The introduction describes the concept of climate change, emphasises the role of ecosystem cooperation in addressing climate change issues and defines the main objective of the article. The literature review section provides an analysis of recent academic publications on climate change and ecosystem cooperation. The research methodology section describes the methods used to conduct the research. The problems of climate change require specific responses and actions from multiple stakeholders. Therefore, the results section highlights the findings of our case study, whose impact on socio-economic and environmental issues was significant. This paper ends with a section on discussions and conclusions.

2. Literature review

2.1 Ecosystem collaboration for climate change

The consequences of climate change are becoming increasingly visible and worrying on a global scale. They affect the environment, people's livelihoods and national economies. Effectively tackling climate change requires an integrated approach and proactive collaboration between different stakeholders with appropriate resources. For example, building a collaborative network between scientists, businesses, governments and private investors can serve as a model for reducing greenhouse gas emissions into the atmosphere. Some cooperation partners can provide financial resources, while others can provide new technologies or valuable human resources. Policy makers will additionally provide the legislative dimension.

According to Lavorel et al. (2019), ecosystems have sufficient resources to achieve major positive results in combating climate change. Proactive behaviour, corporate governance, the development of new products to combat climate change, an emphasis on sustainability and the collection of highly

valuable information from individuals are all tools that can help improve performance in this area. One opportunity that is currently of interest to investors is business models that offer climate solutions.

Scarano (2017) proposed ecosystem-based adaptation as a model for tackling climate change that focuses on reducing greenhouse gas emissions, protecting biodiversity and alleviating extreme poverty. The author suggests that this model emphasises social and environmental aspects and disregards technological and economic considerations. To address these issues effectively, it is necessary to strengthen cooperation between key stakeholders, including policy makers, businesses and non-governmental organisations.

Mori et al. (2013) emphasise the importance of ecosystem management in tackling climate change. By fostering collaboration, an ecosystem-based approach to climate change can produce innovative and cost-effective solutions. The problems of climate change can be addressed more effectively through multi-stakeholder collaboration, as more stakeholders contribute more resources to reduce greenhouse gas emissions, protect the environment and build resilience to future risks.

Furthermore, Malhi et al. (2020) examined the link between ecosystems and climate change and emphasised the importance of mitigating climate change and reducing greenhouse gas emissions. The authors claim that climate change is a collective responsibility and that the first stage in building networks is to identify individuals and organisations interested in and able to contribute to climate change solutions. Innovative and sustainable solutions to climate change can be created through collaboration between different stakeholders.

Carrozza et al. (2020) provided an overview of a selection of European climate change projects and investigated whether funding mechanisms at the European level are being utilised to create an ecosystem of knowledge focused on the complex nature of climate change and the problems associated with it. In addition, the authors explored the relationship between knowledge, entrepreneurial universities and networks and emphasised the importance of universities in creating ecosystems focused on climate change solutions.

2.2 A bibliometric review of ecosystem collaboration for climate change

This section contains a bibliometric analysis of the relationship between climate change and ecosystem collaboration. The aim of this theoretical analysis is to identify the main authors, organisations, countries, journals and publishers with scientific works on our topic. In addition, the analysis sheds light on the evolution of academic publications on climate change and ecosystem cooperation. From a technical point of view, the bibliometric analysis was carried out using a database from the Web of Science. "Ecosystem collaboration" and "climate change" are the two terms used for the study. No time period was chosen, so a selection of academic papers from 1998 to 2024 was made. This led to 852 results from the Science Citation Index Expanded (SCI-EXPANDED), the Social Sciences Citation Index (SSCI) and the Arts & Humanities Citation Index (A&HCI).

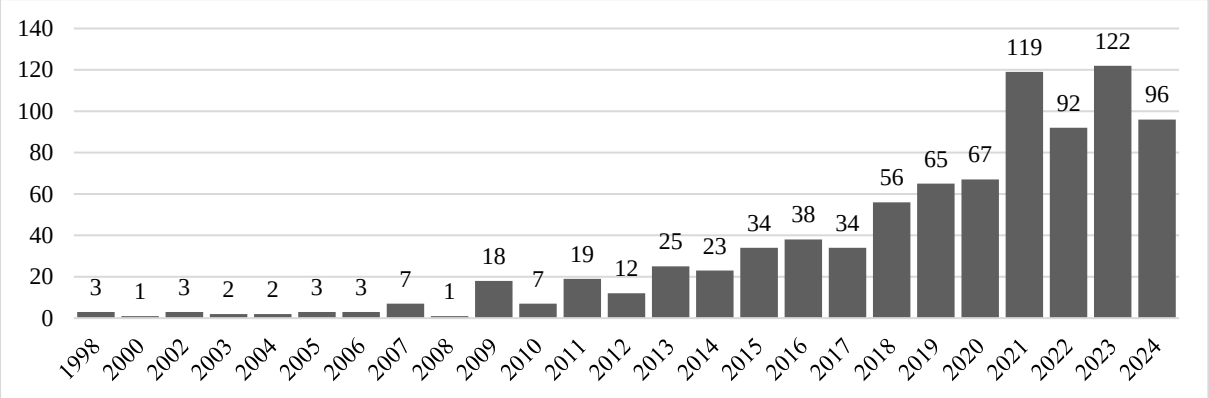

Fig. no. 1: Number of publications on ecosystem collaboration and climate change from 1998 to 2024
Source: Author's own research based on Web of Science database

Figure 1 shows the evolution of academic papers on ecosystem cooperation and climate change from 1998 to 2024. The trend shows a continuous increase over time, with most scientific papers published between 2021 and 2023. By 2024, 96 academic papers had already been published. The research shows that the most recent publications cover topics such as the negative impact of chemical pollution on ecosystems, the urgent need for climate solutions for smallholder farmers, the application of artificial intelligence to environmental issues, the importance of blue carbon in the circular economy, the urgent need for action on the SDGs the role of veterinary medicine in identifying sustainable solutions to climate change-related health problems, the importance of collaborative research in tackling climate change, the impact of climate change on outdoor recreation and the need for collaboration between different stakeholders to develop climate resilient solutions.

Table 1. Top 10 authors by number of publications on ecosystem collaboration and climate change, during the period 1998-2024

Author	Organisation	No. of publications
Brunson, Mark W.	Utah State University (USA)	5
Ban, Natalie C.	James Cook University (Australia)	5
Hobday, Alistair J.	Commonwealth Scientific & Industrial Research Organisation (Australia)	4
Muraoka, Hiroyuki	Tokyo Women's Medical University (Japan)	4
Cheung, William W. L.	University of British Columbia (Canada)	4
Smith, Pete	University of Aberdeen (Scotland)	4
Wamsler, Christine	Lund University (Sweden)	4
Cooke, Steven J.	Carleton University (Canada)	4
Epanchin-Niell, Rebecca	University of Maryland College Park (USA)	4
Yu, Xiubo	Chinese Academy of Sciences (China)	4

Source: Author's own research based on Web of Science database

Table No. 1 shows the top authors from 1998 to 2024 by number of articles on ecosystem cooperation and climate change. As you can see, Mark Brunson and Natalie Ban are the authors who have published the most scientific articles on ecosystem cooperation to mitigate climate change. Mark Brunson is a researcher at Utah State University in the United States of America. In his five scientific papers, the author examines the ecological challenges associated with climate change. In addition, Brunson emphasises the crucial point that effective polycentric governance in addressing climate change requires an understanding of the social and environmental context as well as bringing together the interests of all stakeholders.

Natalie Ban has also authored five academic papers on ecosystem co-operation and climate change. The author is a researcher at James Cook University in Australia. Her main scientific interest is marine planning and conservation. In her studies, the author has proposed the concept of mental models as cognitive frameworks for understanding the world. Researchers could use these cognitive models to improve collaboration in environmental conservation and climate change adaptation. In addition, cognitive models can promote open communication, the sharing of diverse information and a shared commitment to environmental conservation. Natalie Ban also advocates close collaboration between scientists to achieve social change and biodiversity conservation.

Table 2. Top 10 organisations and countries by number of publications on ecosystem collaboration and climate change, during the period 1998-2024

Organisations	No. of publications	Countries	No. of publications
University of California System (USA)	68	USA	369
Centre National de la Recherché Scientifique (France)	43	Canada	125
United States Department of the Interior (USA)	39	Australia	124
United States Department of Agriculture (USA)	37	England	116

Organisations	No. of publications	Countries	No. of publications
University of Washington (USA)	36	China	107
University of Washington Seattle (USA)	36	Germany	97
Chinese Academy of Sciences (China)	33	France	79
Helmholtz Association (Germany)	33	Sweden	61
United States Geological Survey (SUA)	32	Scotland	53
Institute de Recherché pour le Development (France)	28	Italy	52

Source: Author's own research based on Web of Science database

In addition, Table No. 2 shows the most important organisations and countries according to publications on the topic of ecosystem cooperation and climate change. It should be noted that researchers and professors from the University of California System in the United States of America and the Centre National de la Recherché Scientifique in France have worked closely on this topic. The United States of America (369 scientific papers) and Canada (125 scientific papers) are the countries showing the greatest interest in ecosystem co-operation on climate change.

The most important journals in terms of the number of scientific papers on ecosystem co-operation on climate change are Sustainability (31 publications), Frontiers in Marine Science (24 publications), Journal of Environmental Management (17 publications), Environmental Science Policy (13 publications), Marine Policy (13 publications), Science of the Total Environment (13 publications), Ecological Indicators (11 publications), Ecology and Society (11 publications), Ecosphere (11 publications) and Forests (10 publications).

The most important publishers in terms of the number of scientific publications on the topic of ecosystem cooperation to combat climate change are Elsevier (218 publications), Wiley (141 publications), Springer Nature (100 publications), MDPI (80 publications), Frontiers Media SA (50 publications), Taylor & Francis (34 publications), Oxford University Press (26 publications), Canadian Science Publishing (17 publications), Amer Geophysical Union (14 publications) and Resilience Alliance (12 publications).

3. Methodology

A qualitative methodology combining a case study approach and an assessment of innovation management practices in SMEs was applied to provide an insight into the complexity of innovation processes and their impact on the competitive environment of this type of company. The two research methods are the result of a European project carried out at the "Stefan cel Mare" University of Suceava. The name of the project is Innovation Laboratories for Climate Actions (ILCA) and was funded by the European Institute of Innovation and Technology (EIT). The project activities were carried out by a consortium of nine institutions from different European countries. These included six universities (Savonia University of Applied Sciences from Finland; University of Forestry from Bulgaria; Yuriy Fedkovych Chernivtsi National University from Ukraine; King Danylo University from Ukraine; Vilnius College of Technologies and Design from Lithuania; Stefan cel Mare University from Romania) and three research institutes (Lithuanian Research Centre for Agriculture and Forestry from Lithuania; Natural Resources Institute (Luke) from Finland; National Scientific Center Institute Of Agriculture NAAS from Ukraine). The ILCA project focussed on climate change, ecosystem engagement for climate change mitigation, regional development, competitiveness and academic change.

The case study focuses on the characteristics and outcomes of the 'Climate Innovation Laboratory' established within the ILCA project at "Stefan cel Mare" University of Suceava. The aim of this laboratory is to promote innovation and collaboration between professionals from business, educational institutions, society and environmental organisations. Likewise, the establishment of this laboratory within the university will facilitate the promotion of sustainability and the reduction of greenhouse gases at the local level, as universities play an important role in combating climate change.

In addition, the assessment of innovation management practises in SMEs included a questionnaire-based interview with a tourism company from Suceava County, Romania. The qualitative questionnaire entitled "Maturity of the Innovation Management System" (MIMS) was developed by the Finnish

company Innovation Way. The aim of this questionnaire was to assess the degree of compliance of the tourism company's innovation management system with the ISO 56002 standard. This questionnaire allows companies to assess the current state of their innovation systems in relation to the crucial role of innovation in addressing and adapting to climate change. This assessment was carried out in March 2024 with experts from the 'Climate Innovation Laboratory and representatives of the company that created the questionnaire. In terms of structure, the questionnaire assessed innovation performance by examining various dimensions such as context, leadership, planning, support, operations and continuous improvement.

4. Results

4.1 The case of 'Innovation Climate Laboratory' within "Stefan cel Mare" University

An entrepreneurial approach that focuses on sustainability and digital transformation encompasses a set of principles and practices that prioritise social and environmental responsibility in daily business operations. This approach recognises the interconnectedness between business, society and the environment and seeks to achieve a positive impact on all outcomes. The University's long-term strategies include reducing its environmental footprint and promoting sustainability in university operations to foster an environmentally conscious campus and community.

'Innovation Laboratories for Climate Actions' (ILCA) is a European project funded by the European Institute of Innovation and Technology (EIT) focussing on tackling climate change through education, research, innovation, and sustainability. The project was carried out in six universities and three research institutes from European countries. The project was also implemented between 2022 and 2024.

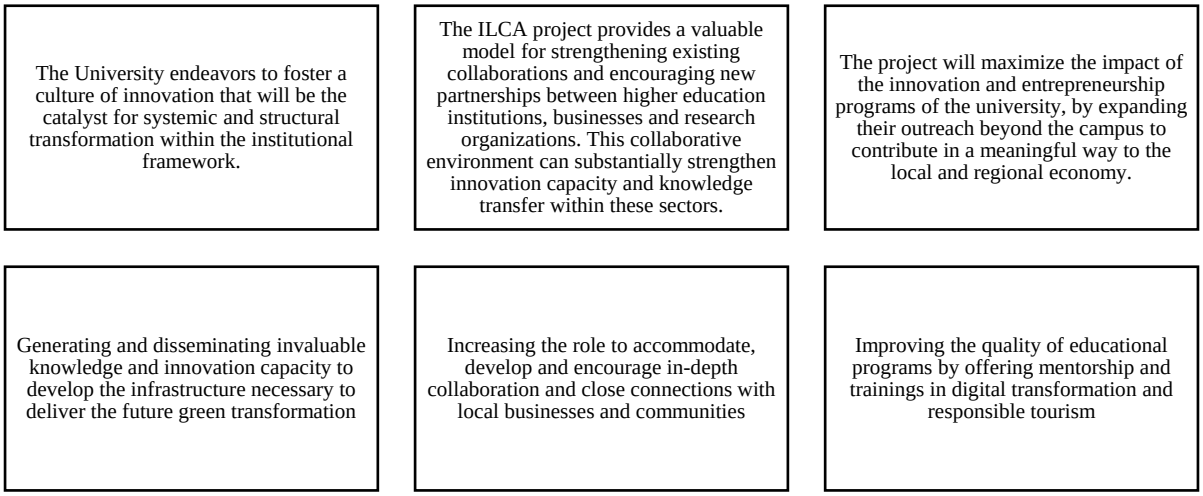

Fig. no. 2. The development of the university in the context of the ILCA project

Source: Author's own elaboration

Figure 2 shows the outcomes of the ILCA project at the "Stefan cel Mare" University of Suceava. As human capital is an important factor in tackling climate change, the ILCA project focussed, among other things, on improving the knowledge of students, academic and non-academic staff at the consortium universities. In addition, this initiative proposed the creation of climate innovation labs at universities to mobilise collaborative efforts to tackle climate change involving multiple stakeholders from the national, regional and local ecosystem. These labs are primarily intended for small and medium-sized enterprises (SMEs) looking for support in developing climate solutions for other companies or institutions in the market and who want to become more sustainable and competitive through innovation and digitalisation. The involvement of relevant ecosystem actors in the development of innovative and sustainable climate change solutions is an opportunity for any region that wants to raise public awareness of the importance of climate change.

Furthermore, the 'Climate Innovation Laboratory' aims to engage a diverse group of stakeholders on the current global problems caused by climate change. To this end, a number of different activities have been carried out within the lab. These activities are illustrated in Figure 3 and are described below.

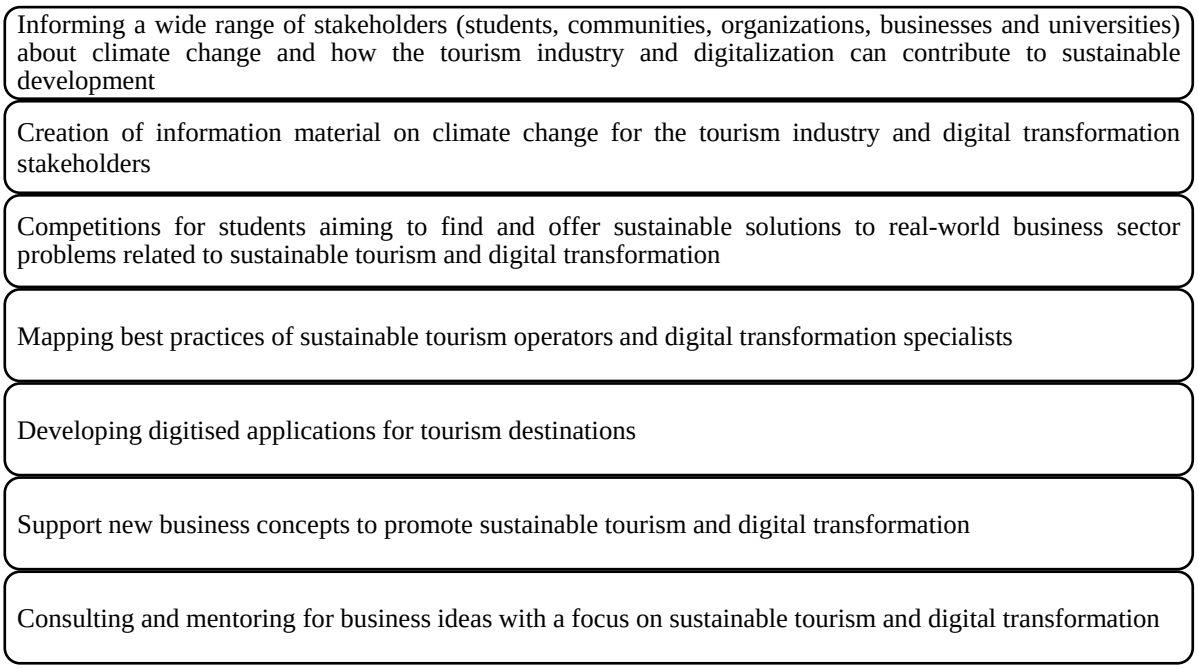

Fig. no. 3. Activities within the 'Climate Innovation Laboratory'
Source: Author's own elaboration

The main activity within the laboratory is to inform and educate students, members of the local community, representatives of different groups or organisations, businesses and academic staff about the crucial role that the tourism industry and digitalisation can play in promoting sustainable development. Information is the first important step when it comes to getting the public interested in a particular topic. People need to have sufficient knowledge before taking action to adapt to climate change.

Another activity of the lab is the production and distribution of educational material on climate change for the tourism sector, stakeholders and interest groups. These resources aim to raise awareness of current climate change issues in tourism and other sectors and promote best practise in this area as a guide for future approaches. In addition, the lab aims to promote the use of digital technologies in business processes, as these make an important contribution to mitigating the effects of climate change.

The lab also organises various competitions for students with the aim of finding and providing innovative and sustainable solutions to real business sector challenges in the areas of sustainable tourism and digital transformation. These activities provide students with an understanding of the current global problems caused by climate change and the competences and skills required to develop appropriate solutions to business problems. Competitions offer numerous benefits for students, including fostering creativity and innovation, enhancing collaboration and teamwork, providing opportunities to apply theoretical knowledge and facilitating contacts with the private sector. In addition, students can become stakeholders in educating businesses about climate change and providing climate solutions that benefit businesses on a global scale. Current student perspectives focus more on current environmental challenges, which could present an opportunity for entrepreneurs in the marketplace.

The lab's experts also focus on identifying best practices in sustainable tourism and digital transformation. Identifying and promoting successful practices in the field of climate change can help other companies to adopt and adapt them, thus improving the level of sustainability through constant innovation and flexibility. Companies that demonstrate their commitment to sustainability and innovation are more likely to attract industry investors and increase their financial value, both in the marketplace and with consumers. The dissemination of best practise on climate change can also encourage co-operation between different actors in the national environment and lead to the development of a community of climate change promoters.

Digitalised tourism applications, such as QR codes, mobile applications and websites, have become increasingly important tools for modern tourism destinations. Therefore, this laboratory aims to support businesses in the digitalisation process by offering advice and mentoring from professionals in sustainable tourism and digitalisation. When it comes to choosing a destination, digital applications can provide useful information about what consumers want. As a significant proportion of visitors make their purchasing decisions online, the applications help to improve contact with customers. In terms of sustainability, advertising via digital applications reduces the demand for printed information material and thus reduces dependence on paper and natural resources, which are limited. Therefore, companies are recognised for their sustainable practices and their efforts to promote sustainable tourism.

The following aim of the climate laboratory is to support innovative business models that combine sustainable tourism and digital transformation. For example, one approach could be to advise companies that are interested in applying for European funding but do not know how to get started. In many cases, the concepts exist, but there are few opportunities to develop the concept further and put it into practise.

Consultancy and mentoring for companies aiming at sustainable tourism and digital transformation is the final activity of the laboratory. Close collaboration between different professionals can help to improve business concepts for sustainable tourism and digital transformation. From this point of view, the laboratory brings together professionals with important experience in climate change, sustainability, social innovation, target group selection and successful marketing. Companies need to gather information on the socio-economic and environmental impact of their business activities to ensure their sustainability. Nowadays, companies need to raise awareness of sustainability among consumers of tourism products.

The creation of the climate change innovation laboratory will bring together stakeholders from the national, regional or local ecosystem. The fields of action for this laboratory can be diverse, ranging from the circular economy to renewable energy sources. This diversity requires collaboration between several actors who can contribute their expertise in different fields of action. In this respect, the university can make a valuable contribution as it has extensive links with the private sector, government agencies and civil society. In addition, the network of other universities within the ILCA project should be explored as they come from different countries and could be an enriching experience. After the permanent identification of stakeholders, their positions, roles and responsibilities within the laboratory should be constantly confirmed.

4.2 The application of MIMS Assessment to a tourism business

Universities have the resources to improve climate protection by supporting start-ups and SMEs in implementing the ISO 56002 standards for innovation management. This approach to assessing innovation management enables companies to evolve into the future by increasing the creativity of their employees and fostering innovation in business processes.

The qualitative questionnaire entitled “Maturity of the Innovation Management System” (MIMS) was developed by the Finnish company “Innovation Way” to assess the level of adaptation of companies to the ISO 56002 standard. This interview-based questionnaire was conducted in March 2024 with the participation of a tourism company and experts from the ILCA project and the ‘Climate Innovation Laboratory. This tourism company is located in a village in Suceava County and mainly offers accommodation, organisation of activities and event spaces.

According to the MIMS assessment, the performance of the innovation management system can be evaluated based on a number of attributes: the degree of compliance with ISO 56002, the ability to recognise opportunities and generate ideas, the ability to achieve, and the ability to add value to innovation and resilience. In the case of the tourism business, the overall level of compliance with the ISO 56002 standard is 40%. The tourism company's ability to recognise opportunities and develop ideas is also at a medium level.

Furthermore, the results emphasise that the company has limited project implementation capabilities. Innovation requires formalised innovation processes and available resources for innovation projects. Similarly, the tourism company's ability to create value through innovation is limited. The resilience of the innovation management system is at a medium level. This position allows the tourism company to

recover from problems arising from the development of innovation projects, but it does not allow the company to respond proactively to anticipated challenges.

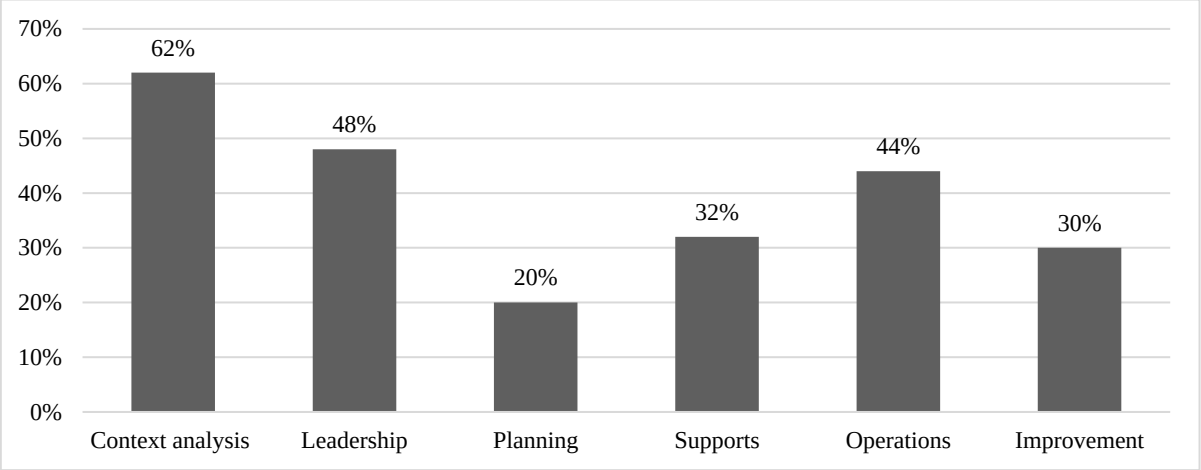

Fig. no. 4. Rate of alignment with ISO 56002 standard
Source: Author's own elaboration

According to Figure 4, analysing the maturity level of the Innovation Management System includes six components: context analysis, leadership, planning, supports, operations, and continuous improvement. In the context of the ISO 56002 standard, 'context analysis' emphasises the need to identify both internal and external elements that impact the innovation ecosystem in organisations. In addition to internal and external challenges, this component also addresses requirements and expectations, scope, culture and collaboration. The results of the MIMS assessment related to the 'Context' component show an alignment with ISO 56002 of 62% (Figure No. 4). To improve this component, the tourism organisation should identify the political, economic, social, technological, environmental, legal and societal factors that affect the organisation's performance. In addition, the tourism business should identify the key strengths in terms of human resources, internal culture, organisation, know-how and technology. Another important phase is to identify all stakeholders (customers, suppliers, partners, public institutions, regulators, etc.) that may be related to the business and build effective partnerships with them. In terms of innovation, the tourism company should encourage employee initiative, networking and collaboration, and an open mentality among employees. In general, employees do not initiate collaborative activities, so management involvement in this process should be emphasised more.

the 'leadership' component includes questions on leadership and commitment, values, vision, strategy and policy, roles, responsibilities and authority. For this component, the results show an alignment with the ISO 56002 standard of 48% (Figure No. 4). The results emphasise the need to further improve the performance of the tourism business in terms of leadership. To demonstrate leadership and management commitment in developing the innovation management system according to ISO 56002, the organisation is expected to consider and implement the following actions: prioritising innovation; implementing an innovation policy; providing continuous support to employees involved in innovation activities; ensuring that employees have access to adequate resources for innovation activities; regularly evaluating the performance of the innovation process; introducing qualitative and quantitative evaluation criteria for each innovation project, process or activity; introducing and accepting the concept of risk in the business process; introducing innovation into the development strategy; communicating the innovation strategy to key stakeholders; discovering novel innovation opportunities; selecting a person responsible for innovation activities; and ensuring that employees have sufficient working time. In addition to the financial benefits of innovation, the tourism business must also communicate other innovation outcomes, such as its market image or the competences of its employees.

In addition, the 'compliance rate with the ISO 56002 standard for the 'planning' component is 20, which is lower than for the other two components (Figure 4). Planning includes objectives and action plans, organisational structures and innovation portfolios. The implementation of innovation in business processes does not lead to immediate results, so some organisations postpone their innovation efforts because they need more time to experience the benefits. Therefore, the tourism companies included in

our research should define precise goals that are in line with the innovation policy and ensure that all employees understand them. Similarly, companies need to proactively create multidisciplinary teams by bringing together employees from different departments and utilising their different skills to achieve innovation goals. The portfolio of initiatives and projects carried out within the tourism organisation must be aligned with the innovation policy. Synergies in innovation projects determine the integrated effort across many projects to achieve more results. Therefore, identifying and utilising synergies can significantly increase the impact and efficiency of innovation activities. Communication is an important factor that promotes collaboration and progress in innovation projects.

The analysis of the tourism company's innovation management performance also includes the "support" component. This includes information on human resources, time for innovation, knowledge and skills, financial resources, infrastructure and awareness. The results for this component show a 32% compliance with the ISO 56002 standard (Figure No. 4). To improve current performance in terms of planning, the tourism industry needs to address the following objectives: promote diversity within project teams; provide financial and non-financial incentives for employees involved in innovation projects; improve HR policies; create a calendar of all project activities and the time allocated to them; provide more time for creative activities within innovation projects; encourage the development and use of new knowledge and skills; create a culture of continuous learning within the organisation that empowers employees and teams to expand their knowledge and develop new ideas that promote innovation; integrate a feedback phase into the implementation process of innovation projects; establish a budget for innovation activities within the organisation; ensure the quality of the infrastructure through continuous investment; develop collaborative projects that can enhance the existing infrastructure; and engage employees and other stakeholders in awareness-raising activities to improve their understanding of innovation and encourage their participation in the development of innovative projects.

The following component, ‘Operations’, includes concepts related to planning, project development, innovation processes, opportunity identification, concept creation, concept validation, solution development and solution implementation. In this scenario, we emphasise an alignment rate with the ISO 56002 standard of 44% (Figure No. 4). To improve operational performance, the tourism organisation needs to develop a series of activities: organising different activities for employees to identify innovation ideas; analysing the seasonality of innovation project activities; closely monitoring innovation project activities to maximise the value created; highlighting abandoned innovation projects and sharing lessons learned from failures; knowing and promoting the differences between classic and innovative projects; promoting the identification of innovation opportunities in all departments of the business; differentiating the concepts of opportunities and ideas, as one opportunity can lead to the generation of several opportunities; using different methods to generate innovative new ideas; implementing a co-design approach from the proof-of-concept phase by involving future customers and relevant stakeholders; implementing scalable projects by quickly adapting to supply, production and distribution channels; implementing solutions after development and monitoring indicators to measure the diffusion of innovations once they have reached the market.

The final component that highlights the performance of the tourism business's innovation management is "Improvement". This section includes the evaluation process, internal audits and improvements. The level of alignment with the ISO 56002 standard is 30% (Figure No. 4), which is low compared to the other components. To improve the performance of the innovation management system, the tourism organisation should take the following actions: Define a set of indicators to measure the value created by innovation projects, regularly evaluate the performance of the innovation management system, and promote continuous progress in the field of innovation.

The Innovation Management System is particularly important for the tourism sector as it enables companies to respond to the frequent changes that occur in the areas of sustainability, innovation and climate change. A well-functioning innovation system can facilitate the development and implementation of sustainable solutions. Therefore, the tourism sector should improve its innovation performance, as several components of the interview (planning, support, operations and continuous improvement) showed low compliance with ISO 56002.

5. Discussions and Conclusions

The establishment of the 'Climate Innovation Laboratory' as part of the ILCA project strengthened ecosystem engagement through proactive climate change mitigation measures, the involvement of local and regional stakeholders and the dissemination of project results. A specific goal of the laboratory was to strengthen ecosystem collaboration by bringing together key stakeholders from many disciplines and sectors such as businesses, entrepreneurs, non-governmental organisations (NGOs), civil society, students and experts. Each of these actors has important resources or assets that could be utilised for climate change mitigation and adaptation.

In Romania, for example, the tourism sector needs to focus on sustainable practices as visitors increasingly choose accommodation that incorporates sustainability into their long-term strategies. More importantly, the tourism industry in Romania has a significant environmental impact through the release of greenhouse gases into the atmosphere. The climate laboratory can contribute to this challenge by using existing resources and the expertise of professionals to provide long-term solutions for tourism businesses that want to minimise their negative impact on the environment. To facilitate collaboration and identify potential partners, the lab's experts could organise regular meetings with stakeholders interested in climate action. Close co-operation between key stakeholders can lead to valuable solutions for climate protection.

In addition, the ILCA project has promoted innovation and sustainability through both the 'Climate Innovation Laboratory and the evaluation of the innovation management system. The laboratory has become an important tool in the development of climate innovation projects that have a positive impact on the region and local communities. From this perspective, research and development activities are crucial for climate innovation initiatives. The transfer of knowledge between different actors with specific resources could be beneficial for the promotion of innovation. This transfer can be achieved by organising events, training programmes, workshops or advisory services for different types of stakeholders. Another important phase is the identification of actors who are not represented in the climate landscape. Once the missing component is identified, the innovation and sustainability efforts related to climate change can be completed and achieve positive results for the environment, individuals and the economy.

The paper emphasises the multidimensional component of climate change and the critical importance of developing solutions to tackle this problem. Through the 'Climate Innovation Laboratory', the ILCA project emphasises the important role that universities play in tackling climate change. Today, educational institutions are catalysts for climate action as they have valuable resources for education, research and innovation. The "Stefan cel Mare" University of Suceava has carried out a variety of activities to tackle climate change, such as raising awareness about climate change, distributing information material on climate change, organising student competitions on climate change and supporting sustainable tourism and digital transformation. Through education and research, universities can improve the collaboration of ecosystems to find innovative and sustainable solutions to the challenges currently posed by climate change.

The ILCA project is an example of innovation in the field of climate change as it has effectively created a collaborative ecosystem of diverse stakeholders engaged in climate change adaptation and solution development. The 'Climate Innovation Laboratory's focus on organising competitions for students is an initiative that encourages young people's creativity and prepares them for the challenges that climate change may bring in the future. Organising multidisciplinary student teams, for example, is an activity that can provide innovative and sustainable solutions to the problems of climate change. Education is a necessity both for understanding climate change and for finding solutions to climate problems.

Similarly, educational institutions that promote the green and circular economy to students could prepare them for future green jobs. Although there are more and more initiatives in the field of climate change, there are still gaps in knowledge among young and older people. Therefore, governments, educational institutions and the private sector need to create opportunities to learn and innovate about climate change. Climate change should be a priority in education and in people's daily lives.

One aim of the 'Climate Innovation Laboratory' was to promote sustainable tourism and digital transformation at local, regional and international level. Many tourism businesses are now endeavouring to become more sustainable as individuals and tourists show increasing interest in sustainable practices and experiences. Educational institutions can promote climate action by providing mentorships and training for digital transformation and responsible sustainable tourism. Stakeholder efforts can integrate sustainable practices into the local economy and empower local communities through innovation and knowledge.

Tourism businesses that incorporate climate change into their long-term strategies could educate tourists and increase their willingness to promote climate solutions. In addition, tourism businesses that are committed to sustainability and address climate change issues could also train their employees in this area. Digital transformation is also crucial to tackling climate change. Digital technologies improve communication with customers, increase companies' visibility, reduce costs and make them more sustainable.

The findings of this paper emphasise how important it is for the tourism industry to improve its innovation capacity for climate action. One important way to improve is to align the innovation system with the ISO 56002 standard. According to the MIMS results, the tourism industry needs to improve some components of the innovation management system, such as planning, improvement and support. The tourism industry therefore needs to regularly evaluate the performance of its innovation management, introduce innovation into business processes, define specific goals related to innovation, create a collaborative ecosystem for innovation, encourage creativity and diversity among employees, set a specific budget for innovation activities and involve employees more in the development of innovation projects.

The article has some research limitations resulting from the bibliometric analysis and the interview-based questionnaire. The bibliometric analysis, using only academic papers from the Web of Science, may have misrepresented the entire research landscape, as other databases may contain relevant and additional papers. Furthermore, the questionnaire describes the results of a single tourism business. In the future, the questionnaire will target a broader range of tourism companies, which will help them to improve their performance in innovation management.

A future research direction is to establish an interdisciplinary research network within the 'Climate Innovation Laboratory', which would allow researchers from different fields such as ecology, economics, society and environment to work together on the complicated issues of climate change and ecosystem management.

Acknowledgements

This paper was supported by the ILCA project (https://ilca-project.eu/) within the EIT HEI Initiative – Capacity Building for Higher Education, funded by the European Union.

References

Amin, M.R., Zhang, J. and Yang, M. (2014). Effects of climate change on the yield and cropping area of major food crops: A case of Bangladesh. *Sustainability*, 7(1), pp. 898-915. https://doi.org/10.3390/su7010898.

Carrozza, C., Cruz, A.R., Nogueira, C., Pinto, H., and Uyarra, E. (2020). European knowledge and entrepreneurial ecosystems: Networks within climate change and adaptation research. *Thunderbird International Business Review*, 62(5), pp. 579-591. https://doi.org/10.1002/tie.22167.

Climate Change Knowledge Portal (n.d.). *What is Climate Change?* [online] Available at: <https://climateknowledgeportal.worldbank.org/overview> [Accesed 02 September 2024].

COP28 UAE (n.d.). *COP28 connects climate-tech ecosystem to drive innovation and inspire climate action*. [online] Available at: <https://www.cop28.com/en/news/2023/12/COP28-connects-climate-tech-ecosystem> [Accesed 02 September 2024].

Innovation Laboratories for Climate Actions - ILCA Project (n.d.). *ILCA project*. [online] Available at: <https://ilca-project.eu/ilca-project/> [Accesed 02 September 2024].

Jacob, D.J. and Winner, D.A. (2009). Effect of climate change on air quality. Atmospheric environment, 43(1), pp. 51-63. https://doi.org/10.1016/j.atmosenv.2008.09.051.

Lavorel, S., Locatelli, B., Colloff, M.J. and Bruley, E. (2020). Co-producing ecosystem services for adapting to climate change. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1794), p. 20190119. https>//doi.org/10.1098/rstb.2019.0119.

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M.G., Field, C.B. and Knowlton, N. (2020). Climate change and ecosystems: threats, opportunities and solutions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1794), p. 20190104. https://doi.org/10.1098/rstb.2019.0104.

Mori, A.S., Spies, T.A., Sudmeier-Rieux, K. and Andrade, A. (2013). Reframing ecosystem management in the era of climate change: issues and knowledge from forests. *Biological Conservation*, 165, pp. 115-127. https://doi.org/10.1016/j.biocon.2013.05.020.

Scarano, F.R. (2017). Ecosystem-based adaptation to climate change: concept, scalability and a role for conservation science. *Perspectives in Ecology and Conservation*, 15(2), pp. 65-73. https://doi.org/10.1016/j.pecon.2017.05.003.

Schulte, P.A., Bhattacharya, A., Butler, C.R., Chun, H.K., Jacklitsch, B., Jacobs, T., Kiefer, M., Lincoln, J., Pendergrass, S., Shire, J., Watson, J. and Wagner, G.R. (2016). Advancing the framework for considering the effects of climate change on worker safety and health, *Journal of Occupational and Environmental Hygiene*, 13(11), pp. 847-865. https://doi.org/10.1080/15459624.2016.1179388.

United Nations (2024a). *What Is Climate Change?* [online] Available at: <https://www.un.org/en/climatechange/what-is-climate-change> [Accesed 02 September 2024].

United Nations (2024b). *COP28: What Was Achieved and What Happens Next?* [online] Available at: <https://unfccc.int/cop28/5-key-takeaways> [Accesed 02 September 2024].

Web of Science (n.d.). *Web of Science*. [online] Available at: <https://1110mozir-y-https-www-webofscience-com.z.e-nformation.ro/wos/woscc/basic-search> [Accesed 04 September 2024].