



Documentary Photography and Spatial Remote Sensing as Tools for Deforestation Reconnaissance in the Amazon

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Abstract. This study explores the potential of documentary photography and spatial remote sensing as complementary tools to address deforestation in the Amazon. Documentary photography possesses the unique ability to capture and communicate the human impacts of deforestation, giving voice to affected communities and raising awareness through powerful visual narratives. On the other hand, spatial remote sensing provides a broad and unbiased perspective, allowing to monitor and quantify changes in forest cover over time and across vast geographic areas. The integration of these two disciplines provides a more complete and holistic understanding of Amazon deforestation. In addition, a qualitative approach and phenomenological design was applied to this study, in which ten semi-structured interviews were conducted with specialists in the field such as photographers and remote sensing professionals. Results were obtained to promote awareness and understanding of this problem. Findings such as the importance of emotional connections through images, use of narrative in photography, management of institutional participation, among others, were identified.

Keywords: Documentary photography, Spatial remote sensing, Deforestation.

1 Introduction

Deforestation is the main threat to the Amazon, as it has negative consequences for the environment, the economy and society. Governments worldwide have declared their commitment to stop it, but they do not obtain the expected results [1]. To identify deforestation, the work of specialists in satellite photographic documentation and documentary studies of photographers investigating deforestation in the Amazon is required [2]. Through these specialties it is observed how deforestation affects forest ecosystems that make the Amazon habitable, providing food, water, economic, recreational, spiritual, health and cultural benefits [3]. The Amazon may face different socio-ecological actions for the conservation and relevance of its ecosystem services, depending on the socio-political and economic context of each Amazonian country

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P. C. López-López et al. (eds.), *Proceedings of the International Conference on Communication and Applied Technologies 2024 (ICOMTA 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 28, https://doi.org/10.2991/978-94-6463-596-6__8

[4]. A better knowledge of local perceptions of deforestation processes could have decisive impacts on public policies to develop adapted strategies and resilient civil societies in regions threatened by deforestation [5]. On the one hand, developed countries can help others to combat deforestation by providing financial and technological assistance and support for conservation efforts. This assists nations in strengthening their laws and policies to protect the environment [6].

In relation to technological support and preservation, documentary photography has an important role in cultural management, since it is considered an effective means of expression and communication, as it documents and represents reality in a visual way [7]. Likewise, photography can record, and evidence changes through images [8]. In turn, documentary photographers make critical reflections on different topics, as in this case deforestation [9]. In addition, by linking photography with remote sensing, maps can be generated from the images that are visualized in critical areas with greater suppression of native cover; such images allow correlating vegetation changes with human occupation processes [10]. In addition, satellite images from different years are used to identify changes in land use and land cover [11]. By providing photographs that present updated metrics and indicators on urban green areas, remote sensing allows governments to have strategic information to identify problems in this aspect and design public policies to address them [12].

At the international level, a study used satellite images to quantify the extent of forests in Santa Fe's *Cuña Boscosa* between 1976 and 2005, showing a 23% decrease in forest cover during that period. This indicates a worrying deforestation in the area, underlining the need to take urgent actions for the preservation of native forests [13]. Another study, in Colombia, indicates that documentary photography made it possible to create a detailed visual record of the *Ibagué* mountain, including its current state, physical and biological characteristics, and the human activities taking place to evidence its deterioration [14]. In Honduras, remote sensing was used to analyze changes in land cover and identified a reduction in the extent of forests and an increase in agricultural and urban areas [15]. In Mexico, documentary photography was used to understand how nature has been transformed by humans [2].

At the national level, deforestation in Peru is a serious concern that has recently reached critical levels. According to NASA data, more than a thousand hectares of forest have been documented lost in the Amazonian department of Loreto, implying a serious threat to biodiversity and natural resources [16]. It is visualized through satellite-captured photographs that, in *Madre de Dios*, deforestation is mainly attributable to illegal mining. In 2017, illegal gold mining was responsible for 38% of the region's forest loss [6]. Likewise, in Loreto, the satellite provided images that offer data about how forest biomass is distributed in the Amazon basin. It is a useful tool for monitoring deforestation and land use changes in this area [17]

However, in the search for academic precedents, there are no data or references that address the issue of how to directly link documentary photography with remote sensing. Therefore, this study seeks to answer the following questions: How can documentary photography raise awareness about deforestation in the Amazon? How can documentary photography and spatial remote sensing be related to understand the problem of deforestation in the Amazon?

2 Methodology

This study is framed within the phenomenological paradigm with a qualitative approach. It is based on the understanding and interpretation of people's attitudes, behaviors, ideas, and opinions within a specific context. The main objective is to obtain valuable information that allows for a better understanding of certain social problems and, consequently, to propose appropriate solutions [18]. Phenomenological design is applied, as it focuses on the detailed study of the experiences of a group of people who share a culture or are part of a specific community [19].

The participants in this study are individuals with extensive experience in documentary photography and specialists in spatial remote sensing. Experienced documentary photographers have been selected for their ability authentically and faithfully capture the essence of natural areas such as the Amazon [20]. Remote sensing experts have a long history in the field and have employed a specific methodology to develop this dataset as mapping and effects generated by human activity in the Amazon, through visual analysis of high-definition satellite imagery [21]. Likewise, the Amazon was selected because of the alarming situation evidenced in a recent report, where there are 5806 hectares of deforested forests, of which 3183 are located native communities [22].

The sampling is snowball sampling, since the interviewees were the ones who provided the data of other contacts, being a specific and limited group [18]. To collect the data, 10 semi-structured interviews were conducted (Table 1) with open-ended and dynamic questions. These questions allowed participants to express their opinions and perspectives in a free and fluid manner. Specific topics were explored in depth without losing the ability to adapt to new ideas and perspectives that emerged during the interviews [23].

The instrument is divided into two parts: a) Documentary photography as a means of raising awareness about deforestation in the Amazon and b) The relationship between documentary photography and spatial remote sensing to understand the problem of deforestation in the Amazon. Before beginning the interviews, three pilot tests were conducted to ensure that participants understood the questions. This measure allowed us to identify possible ambiguities and adjust the instrument to improve the quality of the answers. Additionally, an information sheet with detailed information

about the research was given to all participants. The information sheet explained the objectives of the study, the research procedures, confidentiality measures, and the handling of personal data. This information was provided to ensure the transparency of the study and to protect the rights of the participants.

The interviews were conducted between March and April 2024, through video calls on the Zoom platform, due to the tight schedule of the participants and seeking greater flexibility in coordination. The duration of each interview was between 45 minutes to 50 minutes. Finally, the collected data were subjected to a four-stage thematic analysis process: 1)Converting the recorded interviews into a Word document; 2)Carefully reviewing the transcribed interviews to obtain a complete understanding of the information; 3)Employing thematic coding techniques to identify and organize recurring themes within the interview data; 4)Synthesizing the information collected and presenting it in a structured format [24].

Table 1. Characteristics of the participants

Participant	Age	Sex	Profession	Duration
P01	32	Female	Forestry Engineer	00:45:00
P02	32	Female	Forestry Engineer	00:45:00
P03	25	Male	Forestry Engineer	00:45:00
P04	26	Male	Forestry Engineer	00:45:00
P05	38	Male	Forestry Engineer	00:45:00
P06	39	Male	Photographer	00:45:00
P07	29	Male	Photographer	00:50:00
P08	42	Male	Photographer	00:45:00
P09	49	Male	Photographer	00:48:00
P10	28	Male	Photographer	00:45:00

3 Results and discussion

3.1 How can documentary photography raise awareness about deforestation in the Amazon?

After analyzing the comments provided by the interviewees, 3 main ideas can be identified: a) Emotional connections through images, b) Use of narrative in photography and c) Management of the participation of institutions together with photographers.

a) Emotional connections through images

Interviewees argue that the use of images is another mode of producing emotional ties that seeks to deepen awareness of deforestation at the individual level. Several people qualified the possibility of these emotions reaching those who are unaware of the situation. According to interviewees, photos are a powerful tool to illustrate the impact of deforestation in the Amazon, showing the magnitude of the problem and its consequences. It is crucial to use a variety of photographic approaches, from images illustrating the increase in deforestation to personal stories of those affected, to convey the urgency of the situation. Documentary photos are especially effective in raising awareness and motivating positive change, informing, and inspiring the public to take action to protect the Amazon rainforest. Thus, the present finding is consistent with recent research [25] indicating that photographs have great power to bring people together and can be an effective tool to promote conservation. By sharing these images along with their stories, citizens can inspire others to take action to address environmental challenges. On the other hand, a study [26] mentions that photography, from its origin, goes beyond capturing images, it also establishes emotional bonds with the viewer and acts as a bridge between people and their environment. It invites to feel and connect with history and heritage. Along the lines of Monteiro & Etcheverry [27] comments on how photography has a crucial role in documenting and raising awareness of environmental issues, underlining its relevance. By exhibiting images that illustrate the impacts of these events, the unique ability of photography to communicate realities directly is highlighted. In conclusion, documentary photographs are powerful tools to communicate the impact of deforestation in the Amazon in a profound and impactful way. It uses a diversity of photographic approaches to show the magnitude of the problem, the stories of the people affected, and the urgent need for action.

"The subject being photographed, be it a plant or be it a person, you don't see it as inferior or as necessarily superior, but as in a horizontality that puts you on the same level and allows you to connect emotionally with what you see." (P06)

"I consider that I have felt feelings of sadness, sorrow or concern, when I have seen satellite images. You see changes of 10 years, 20 years, and how the forest is shrinking." (P05)

b) Use of narrative in photography

Interviews with experts in satellite photography reveal essential insights for the effective use of narrative in photography, especially in environmental conservation. Interviewees highlight the importance of telling stories of change, such as Amazon deforestation, through satellite imagery. They recommend focusing on individual stories that show how change affects people, through photobooks or documentaries that combine images with written stories. They suggest using narrative techniques such as the hero's journey and characters to create engaging stories, combining formats such as images, audio, video, and text to achieve immersive experiences. From these findings,

it is perceived how it relates to Crilley & Chatterje's study [28] as it mentions that emotionally charged visual narratives are essential to validate and gain support in the search for a solution to the problem. A combination of visual, auditory, and textual techniques was employed to create an emotional narrative that effectively depicts the problem. On the other hand, a study [29] explains the ability to generate discourse in a variety of contexts using an effective visual narrative. Photography not only captures moments and objects, but also conveys stories and knowledge, being a fundamental tool in the transmission of information and the construction of meanings in society. A recent study [30] mentions that images are powerful tools to captivate the audience and generate a lasting impact. In summary, storytelling in satellite photography for environmental conservation requires compelling storytelling that connects emotionally with the audience and uses a variety of creative media and techniques. These can raise awareness and promote environmental conservation, motivating people to take action to protect the planet.

"When we talk about image, it implies not only the visual image, but also a moving image. There is also a kind of image in graphics, in illustrations, even a word image. In other words, the image is a discourse of different situations" (P08).

c) Management of the participation of institutions with photographers

Interviewees comment that collaboration between documentary photographers and environmental organizations allows for the promotion of academic activities to collaborate effectively and create a better trained group of professionals. This emerges as a key strategy to raise awareness about deforestation in the Amazon. These alliances help the learning of resources and technologies needed to understand and address environmental issues using tools such as remote sensing and documentary photography, which contributes to a deeper and more meaningful understanding of environmental problems and their potential solutions. Organizations, by providing funding, resources, and promotion, not only facilitate, but actively support the work of photographers on this crucial topic. Some interviewees emphasized that work between photographers and remote sensing specialists could generate exhibitions, campaigns and events that can connect with wider audiences. Thus, generating a more significant impact on awareness and action regarding deforestation in the Amazon region. A

study [20] mentions that research groups from different areas are interested in analyzing and reflecting on images that represent the current environmental situation. This action seeks to highlight a problem and points out the relevance of these images as tools to communicate and promote knowledge, awareness, and environmental protection. A recent study [31] mentions that cooperation among researchers boosts environmental education and fosters the development of skills for action and critical reflection. By employing innovative tools and emerging technologies, this collaboration between researchers and documentary photographers can be a driver for generating positive change with people's interaction with their natural environment [32]. In summary, collaboration between environmental organizations and documentary photographers can be instrumental in amplifying the impact of photographic projects on deforestation in the Amazon. Organizations can provide key resources such as funding, access to resources, and advocacy. These resources are invaluable in making the projects more visible and far-reaching.

"The most respectful and important thing with the work of the documentary photographer is that the organizations help you in the dissemination of your project or in financing." (P10)

3.2 How do documentary photography and spatial remote sensing relate to understanding the problem of deforestation in the Amazon?

After analyzing the comments provided by the interviewees, two main ideas can be identified: a) They are a tool to identify deforestation and b) They serve as a monitoring tool for deforestation.

a) They are a tool to identify deforestation

According to interviewees, remote sensing with satellite imagery and documentary photography are essential tools for identifying and understanding deforestation in the Amazon. Remote sensing provides a broad and objective view of the extent and patterns of deforestation, while documentary photography captures human and environmental impacts more closely and emotionally. As such, these images give voice to the people and stories behind these dramatic changes. Bringing these perspectives together provides a deep understanding of the challenges and consequences of deforestation, which helps to promote effective action to protect this crucial ecosystem. This finding is related to a study [10] The study mentions that using remote sensing, it is possible to create images that show the environmental damage in the Amazon and facilitate the connection that has the impact of man on nature. On the other hand, along the lines of Blanco [33] mentions that documentary photography plays a crucial role in emphasizing social issues such as deforestation. Through visual narrative, it contributes to education, the transmission of emotions and awareness of this problem. Therefore, the integration of spatial remote sensing and documentary photography is an invaluable

tool for a thorough understanding of the problem of deforestation in the Amazon. A more complete and profound vision of this complex phenomenon can be obtained, generating greater awareness, and promoting more effective actions for the protection of this vital ecosystem.

"A satellite image not only captures an image in the visible range but gives you much more information. This information can be documented, and a record can be generated to analyze the changes that are occurring in the Amazon" (P05).

b) They serve as monitoring of deforestation

According to interviewees, remote space sensing is a very valuable tool for monitoring changes in the Amazon's vegetation. Thanks to its wide geographic coverage and constant monitoring, this technology makes it possible to accurately identify areas that have been deforested and to track them over time. In addition, some interviewees indicated that it provides an objective and quantifiable view of deforestation, which is essential to inform decision-makers and natural resource managers about the severity and dynamics of this situation. In this way, appropriate action can be taken to address the problem. For documentary photographers, satellite imagery is a very useful resource. They allow them to plan their projects, identify key areas to photograph and visually contextualize their stories about deforestation. This helps them work more efficiently and safely on the ground. This finding is consistent with a study conducted by Urquiza & Burga. [17], which mentions that satellites provide images to researchers showing environmental damage and highlights their usefulness in monitoring deforestation in the Amazon. On the other hand, a recent study [34] indicates that satellite monitoring contributes directly to the supervision of natural areas, which facilitates the identification of illegal activities. This makes it possible to apply sanctions in accordance with established laws. In addition, along the lines of Cáceres [35], he comments that it is essential to promote environmental awareness to encourage reflection on the impact on the environment, both globally and locally. In summary, spatial remote sensing is a powerful and effective tool for monitoring deforestation in the Amazon. It offers advantages such as geographic coverage, long-term monitoring, and objectivity. In addition, satellite imagery can be of great use to documentary photographers in planning, conducting, and communicating their work.

"Visually, from the air it looks a strange thing, doesn't it? But together with a vertical image or a field image it will give a complete picture. So, with that it's going to be much more interesting information. It's definitely going to help you as a guide." (P02)

"Yes, all this satellite imagery gives you a frame of reference, right? A much more accurate framework and that gives you a much more globalized picture of ideas about what you have to build." (P09)

4 Conclusions

This study concludes that documentary photography, when coupled with emotive narratives and collaborations between photographers and environmental organizations, emerges as a powerful tool to raise awareness about deforestation in the Amazon. These powerful images, backed by moving stories and institutional support, have the power to raise awareness, inspire change and encourage action to protect the ecosystem.

Second, the relationship between spatial remote sensing and documentary photography provides a comprehensive understanding of deforestation in the Amazon. Remote sensing provides an objective and comprehensive view of the extent and patterns of deforestation, while documentary photography captures the human and environmental impacts in an emotive way. This integration allows for a deep understanding of the problem and facilitates the promotion of effective actions to protect this ecosystem.

This research highlights the importance of adopting interdisciplinary and collaborative approaches to address complex challenges such as deforestation. By combining space-based remote sensing and documentary photography, it raises awareness, informs decision makers, and promotes more effective and sustainable solutions to protect the Amazon and its biodiversity.

There were several notable limitations that impacted the data collection and analysis of information in this study: a) There were difficulties in contacting remote sensing specialists related to the Amazon and b) Interviewing a small sample did not allow for generalization of results. Finally, for future research, it is suggested to develop specific methodologies and workflows between photographers and remote sensing specialists. In addition, the real impact of these visual initiatives on public awareness and environmental policies should be analyzed.

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