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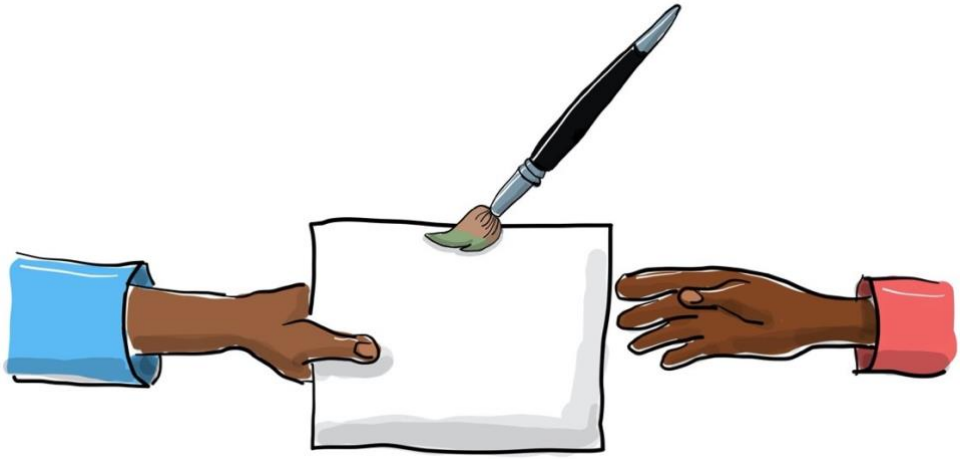
A creative approach for social-ecological science communication at Mt Kilimanjaro, Tanzania

Bachelor thesis



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List of abbreviation

FGDs: Focus group discussions

HNC: Human-nature connectedness

IPBES: Intergovernmental Platform on Biodiversity and Ecosystem Services

Kili: Kilimanjaro

Kili-SES: The research project “the role of nature for human well-being in the Kilimanjaro social-ecological system”

NASEM: National Academies of Science, Engineering and Medicine

NCP: Nature’s Contributions to People

SES: Social ecological system

UNESCO: United Nations Educational, Scientific and Cultural Organization

1. Introduction

In social-ecological science research, the use of arts-based methods is an emerging field (Biggs et al., 2021). Arts-based methods are mainly used in the research process, but its effective potential to enhance the communication of scientific information in the context of outreach and the return of findings needs to gain more attention (Lesen et al., 2016; Leavy, 2019; Muhr, 2020). However, there is a great lack of scientific reports about returning results to research participants, and even more so in social-ecological research. Above all, there is a lack of scientific knowledge about the use of art in this context (Biggs et al., 2021).

This bachelor thesis attempts to illustrate the power of art in the context of social-ecological science communication. It is embedded in a social-ecological research project in the region of the Kilimanjaro in Tanzania which studies contributions of nature to people (NCP). NCP refers to all of the positive and negative contributions of nature to people's quality of life (Christie et al., 2019). The project focuses on the demands for and values of these contributions expressed by a wide range of stakeholders. The main objectives of the thesis are to illustrate and explore the application of art in science communication. Hence an overview about important steps and considerations when returning research findings to participants is provided. For that, a creative approach to returning research results in the context of the social-ecological research project Kili-SES will be used as a case study example.

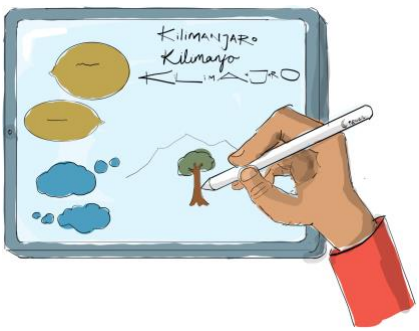


Figure 1: A creative approach to returning research results

To begin with, a literature review sets the context for this thesis and provides an overview of the key ethical considerations when returning research results, as well as how arts-based methods can be used in this regard. Next, the research project “The role of nature for human well-being in the Kilimanjaro social-ecological system” will be used as an example on how arts-based methods can be used for the return of research results to participants. A focus will

be on the use of visualizations and graphic design to communicate findings. Here, the process and steps for the development of material for the outreach tour of the project will be illustrated. In the result section, the main outputs will be presented in the form of four posters which were displayed during the communication of findings. In a discussion, the posters and the process of the development will be critically reflected upon. Collected feedback from informal conversations with participants will be included, providing a basis for the discussion. This thesis will conclude with possible important considerations on how to use art for the return of research results, and why more literature on this topic is important for social-ecological research.

2. State of the art

2.1. A lack of the return of research results to participants

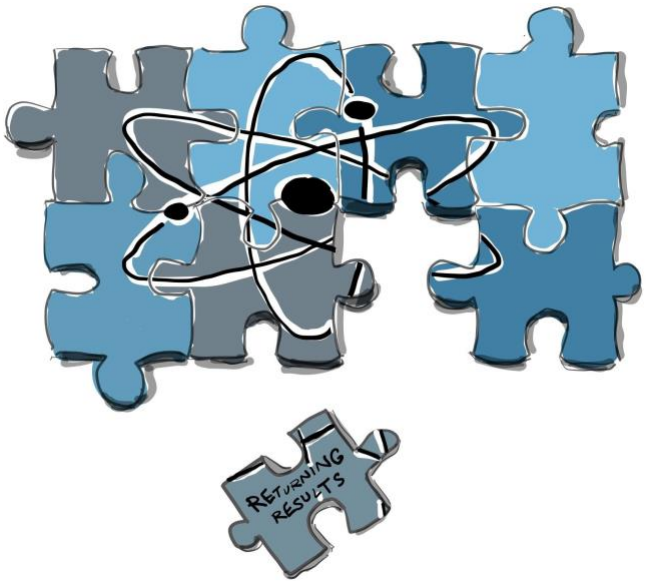


Figure 2: A lack of returning results

In mainstream western scientific research, the communication of study findings to research participants is not a standard routine. Often researchers either do not return findings at all or fail to effectively communicate findings (Hintz & Dean, 2020). Trying to give ethical orientation for decision making whether research findings should be returned, especially in the domain of social science, one possibility is to use the 'Mertonian norms', also referred to as the "best-established norms of science" (Medvecky & Leach, 2017, p.2). As one of the norms is defined as communalism, "scientific knowledge is owned in common by the whole scientific community", one could argue that research results should be owned by the society more

broadly (Medvecky & Leach, 2017, p.2). In addition, the need for transparency is often highlighted, which is considered as important for researchers accountability (NASEM, 2018).

2.1.1. Potential risks

But experts also point to the great power of the influence of science communication and the importance of ethical reflection and the consideration of possible risks (Medvecky & Leach, 2017; NASEM, 2018; Hintz & Dean et al., 2019). Hintz and Dean (2020) summarize potential risks of returning findings as "failing to minimize harm, causing emotional distress or confusion, and financial costs" (p.40; cited from Cooper, 2008; Fernandez et al., 2003; MacNeil & Fernandez, 2007). The lack of feasibility of the return is often part of the discussion, which is linked to limited resources and capacities of the researchers (Hintz & Dean, 2020). Furthermore, barriers for the return can include difficulties to contact participants again (Hintz & Dean, 2020) or the assumption that participants might not be interested in the results or do not understand findings (Taylor, 2019). Most barriers and risks mentioned here are mainly findings from the medicine research domain, with a lack of literature on those issues in other research domains. Next to the factor of "feasibility of return", the National Academies of Science, Engineering and Medicine (NASEM) states that the decision regarding the return of research findings should be weighted on the "potential values of information" for participants, the "nature of the relationship" between the participants and the researchers and the "validity of the research results" (NASEM, 2018, p 20). Thus, researchers point out that potential risks and barriers need to be taken into account when deciding whether to communicate results to participants. But for ethical reasons and the overall potential advantages for participants, many argue that the benefits outweigh the costs (Hintz & Dean, 2020; Taylor, 2019).

Figure 3: Benefits outweigh costs

Moreover, regarding today's global challenges, reporting findings to participants and broader society, especially in sustainability science, needs to be considered. As described by Moser & Dilling (2009), “The need for effective communication, public outreach, and education to increase support for collective action and behavior change is perhaps most pressing in the context of anthropogenic climate change” (p.2).

2.1.2. Benefits when returning research results

Key benefits of returning research results can include the reinforcement of the importance of a participant's role in the research project and possible learning effects. Furthermore, the feedback from and exchange with participants can benefit the reflection about the scientific work. Transparency is another important benefit to ensure that participants know how their data is being used and whether it has been interpreted accurately (Hintz & Dean, 2020; Taylor, 2019). Other experts highlight the high gain of trust, which can be strengthened and built up, as a main benefit and advantage (NASEM, 2018). Taylor (2019) calls the reporting of research findings to participants an “ethical imperative” (p.1). The new knowledge can represent power for participants and foster public understanding. Therefore, risks or concerns in this context should not be reasons for “avoiding communication, but for doing it well” (Taylor, 2019, p.1). However, especially ‘doing it well’ needs ethical orientation and guidance.

2.1.3. Ethical principles and considerations for science communication

When doing research, especially in the domain of social science, when working with different people, diverse perceptions and worldviews, there are important ethical aspects that need to be considered. Weinbaum et al. (2019) have defined ten ethical principles for scientific research based on the 200 most-cited peer-reviewed articles on ethics in scientific research from different disciplines (see appendix 2). The principles vary from scientific inquiries to ethical behaviors of researchers or the principles for working with participants (Table 1, Weinbaum et al., 2019). They apply to the whole research process including the step of returning research results. In a further broken down category on the ethical treatment of participants, the principles of “Informed consent”, “Beneficence”, “Nondiscrimination”, “Non Exploitation”, “Privacy and confidentiality” are applied. For the principle of beneficence, it is stated: “Researchers should have the welfare of the research participant in mind as a goal and strive for the benefits of the research to outweigh the risks” (Weinbaum et al., 2019, p.10).

Categories of Ethical Principles

Category	Description of Category	Ethical Principle
Ethical scientific inquiry	The research inquiry itself must benefit society.	• Duty to society
Ethical conduct and behaviors of researchers	Researchers should conduct themselves in certain manners, and they are responsible for their knowledge and awareness of ethics and appropriate research methods.	• Conflict of interest • Integrity • Nondiscrimination • Professional competence • Professional discipline
Ethical treatment of research participants	Research participants should be treated according to certain guidelines and treated humanely, and the environmental or secondary effects of the research should be considered.	• Informed consent • Beneficence • Nondiscrimination • Nonexploitation • Privacy and confidentiality

Table 1: The ethical principles regarding the treatment of research participants according to Weinbaum et al., 2019

Other researchers summarize key ethical principles when returning findings to participants as follows: "Respect for persons/autonomy", "non-maleficence" and "beneficence", defined as the "provision of benefits to participants" (Hintz & Dean, 2020, p. 41). A fourth ethical principle of "Justice", involving the distribution of benefits to all contributors, is proposed by Ferris & Sass-Kortsak (2011). The European Commission also created guidelines for research conducted with their funds in the domain of social science and humanities. One of those guidelines states that "honesty and transparency towards research subjects" needs to be ensured (European Commission, 2021, p.6).

Figure 4: Ethical principles

Conducting research in other countries and working with Indigenous communities, ethical principles should always guide the research. Ethical guidelines from Indigenous peoples themselves are particularly appropriate here. One code of conduct from the Indigenous people of San in South Africa states four central values of "fairness", "respect", "care" and "honesty"

that always need to be included in the research process (Chennells & Schroeder, 2018, p.4). “Failure by researchers to meet their promises to provide feedback is an example of disrespect which is encountered frequently” is also mentioned in their code of conduct (Chennells & Schroeder, 2018, p.13). Having this in mind, the step of returning research results to participants is highlighted as even more essential to meet ethical principles.

2.1.4. Important approaches for the return of research findings

There are ethical guidelines for the process of research but for the step of returning research results to participants, few orientation exists. For example, many research processes have been documented on the recruitment of participants, gathering data or the use of different methods, but there is only little literature on the step of returning findings to participants (Hintz & Dean, 2020). Approaches that can be considered as important for the return of findings are ‘reflexive’ and, depending on the context, also ‘anticolonial research’ approaches.

2.1.4.1. The concept of ‘reflexivity’

The concept of reflexive research is seen as “closely connected with ethical practices in social, qualitative research“ (Hart et al., 2017; Guillemin & Gillam, 2004, p.274). For Guillemin & Gillam (2004) a reflexive researcher is one who is “aware of all the potential influences and is able to step back and take a critical look at his or her own role in the research process” (p.275).

Figure 5: A reflexive researcher

Therefore, a constant reflection of the responsibility or privileges and influence that comes along with the role of a researcher, are key. This means also an awareness about the influence

of researchers' responses and input to the research project which needs to be considered. Therefore reflexivity has an important role also in the context of returning research results (Guillemin & Gillam, 2004). Olmos-Vega et al. (2022) suggest practical guidelines to implement reflexivity in research. This includes also to take "space and time for reflexivity" highlighting the documentation about the research process as an important aspect (p.249). Since the return of research findings often also documents parts of the research, it can support the reflection of the whole project, reinforcing researchers' "reflexivity".

A reflexive way of conducting research, can prepare researchers to be more aware of "ethically important moments", as well as act and "respond in ways that are likely to be ethically appropriate" (Guillemin & Gillam, 2004, p.277). Acting reflexive includes putting research practices under scrutiny, being sensitive to all ethical dimensions of the research practice, and through that, being able to recognize ethical dilemmas and deal with them in an appropriate way (Guillemin & Gillam, 2004). When doing research, within a known cultural and societal setting but also outside of the same culture, especially when working with different marginalized groups, reflexivity needs confrontation with power-structures, different privileges and colonial backgrounds. This can require "vigilance, critical reflexivity, self-examination of one's motives, and the ability to tolerate discomfort and one's personal pain at one's complicity in colonial systems" (Hart et al. 2017, p.341, cited from Tuck & Yang, 2012). Here the reflexive research approach comes along with the concept of anticolonial research.

2.1.4.2. The concept of 'anti-colonial research'

When research is conducted in contexts of former colonial structures, given the known history of racial and ethnic exploitation, researchers should confront themselves with an anti-colonial approach of doing research. Researchers underline that the complexity of the context of anti-colonial and decolonial work must be considered and attempts towards it used with caution. Tuck & Yang (2012) highlight that "decolonization brings about the repatriation of Indigenous land and life; it is not a metaphor for other things we want to do to improve our societies (...)"(p.1). Anti-colonial research can be defined as "the political struggle of colonized peoples against the specific ideology and practice of colonialism" by "emphasiz[ing] the need to reject colonial power and restore local control" (Ashcroft et al., 2013, p. 11). A longer discussion would be necessary here to go into detail. Since this would exceed the capacities of this thesis, it can only be highlighted as an important consideration in the context of the research project, touching upon a few reflections associated with it for researchers.

For anti-colonial research, Indigenist research from Indigenous scholars needs to be given space in academia. Nonetheless, since the number of Indigenous researchers is very low, researchers who are not in the Indigenous community but are „working to be allies to Indigenous peoples, who are acknowledged as such by Indigenous people," are considered to have an important role (Hart et al., 2017, p.340). In this context, they also have different responsibilities and tasks. They need to ensure that actions do not reinforce colonial structures, even if the aim is to do „good for the colonized" (Hart et al., 2017, p.340). Instead, actors of the colonized group need to recognize the complex structures of colonialism, and put the self-determination of Indigenous people as the priority of the research process. Main considerations that are highlighted by Hart et al. (2017) for doing anti-colonial research include for researchers to confront themselves with the colonial structures and power inequalities, dedicating themselves to Indigenous values, as well as using their knowledge for the goal to bring positive change for Indigenous people. Moreover, the recognition of the central value of relationships is highlighted, pointing at the importance to enforce and build trust which can have a positive impact on relationships. In addition, transparency through the whole research process and participation engagement are relevant aspects of an anti-colonial research approach. Recommendations and advice for reflexive and anti-colonial research can differ according to the research discipline or research aim. But all in all, it can be guiding for the return and communication of findings (Hart et al., 2017).

2.1.5. How to…? Guidance for communicating scientific findings

Figure 6: How to communicate findings?

A paper by Hintz & Dean (2020) proposes an analytical framework based on ethical principles for "best practices for returning research findings to participants". Before planning the return

of research findings, participants should be asked whether they want to receive information about findings or not. If participants refuse, no further actions should be taken (Hintz & Dean, 2020). If participants agree, important aspects need to be considered.

To begin with, the questions arise: what should be returned, when, and how? And what might be most valuable to participants? To meet the ethical principle of "beneficence," researchers should decide on these questions aiming for the maximum benefit for participants. Deciding on the question of what needs to be returned, most importantly, the study findings that are aimed to be published need to be included (Hintz & Dean, 2020). Fernandez et al. (2003) recommend the development of a finding report which can be returned, including the context and goal of the study, major findings and limitations of the results. Moreover, findings that can have actual meaning and can benefit participants should be considered for return. For that, an identification of target groups is necessary and can be achieved by engaging with stakeholder groups and their preferences (NASEM, 2018). Since diverse audiences need diverse approaches on how to return data, their characteristics, life realities need to be considered (NASEM, 2018). Therefore the design of separate outreach-material may be necessary. Here, a distinction between “individual-level findings”, findings “specific to an individual participant”, and “general findings”, results which “broadly offer findings about the outcome of research”, might be useful in this context (Hintz & Dean, 2020, p.46).

So this also comes hand in hand with the question of how research results can be communicated. Some advice is given by Hintz & Dean (2020), underlining the advantages of communicating results in a direct way to participants. Moreover, the researchers themselves, or people directly involved in the project, should be in charge. This can build trust and is an important prerequisite for the understanding of the research. If a direct manner of returning findings is not possible, researchers should use other, preferably face to face ways to communicate findings that always ensure the possibility for participants to ask questions (Hintz & Dean, 2020). So all in all, science communication is not only about conveying content, but the skill to adapt and prepare findings according to the variety of perspectives and preferences of the audiences. Here the return of results requires recognition about objectives and intentions behind it, for example steering of beliefs, motivations or behavior (Hintz & Dean, 2020; NASEM, 2018). One main aspect of communicating study findings is to adapt to the language of participants, since participants should obtain all information they need to interpret the findings. Only this way, participants get the chance to also benefit from findings (Fernandez et

al., 2003; Hintz & Dean et al., 2019; NASEM, 2018). Furthermore, literacy or numeracy barriers need to be addressed. The use of a plain language or materials that are based on participants preferences can be useful. Moreover, another way that can enhance understandability, is the use of arts-based methods to improve the communication of findings (NASEM, 2018).

2.2. Arts-based methods and potentials of visualizations in science communication

The integration of art in the field of science communication has received more attention in recent years (Lesen et al., 2016; Biggs et al., 2021; Leavy, 2019; Muhr, 2020). Especially in the context of natural and social science communication and research in the domain of sustainability, arts-based methods are becoming increasingly recognized (Biggs et al., 2021; Curtis et., 2012). Although arts-based methods can vary a lot in their application across disciplines and contexts, this thesis will focus on visual art using visualizations and graphical design.

According to Leavy (2017) arts-based visual research is defined as the creation and use of "various forms of visual art as a way to collect data, conduct analysis, and or represent research" (p.313). Looking at advantages that art can have in general for science communication, Lesen et al. (2016) sum up that it can "elicit visceral, emotional responses and engage the imagination in ways that promote action or behavior change". (p.2) The potential of arts-based visual methods to simplify and convey complex scientific findings can make information easier to remember. Furthermore, this method has the ability to strengthen learning processes, evoke emotions and even change attitudes. This can reinforce the "attention to a problem and raise awareness" (Lesen et al., 2016, p.8). Materials involving art can attract more attention than traditional, only written ones, since they are more appealing to the viewer's eye and amplify curiosity (Lesen et al., 2016). Furthermore, they can offer new perspectives of looking at issues. Arts-based methods are often used in political contexts, to draw attention to a problem and strive for change, for example they have the "potential to give a voice to marginalized groups or silenced perspectives" (Curtis et al., 2012, P.8) Such characteristics make arts-based visual methods a "valuable tools for science communication" (Curtis et al., 2012, p.8).

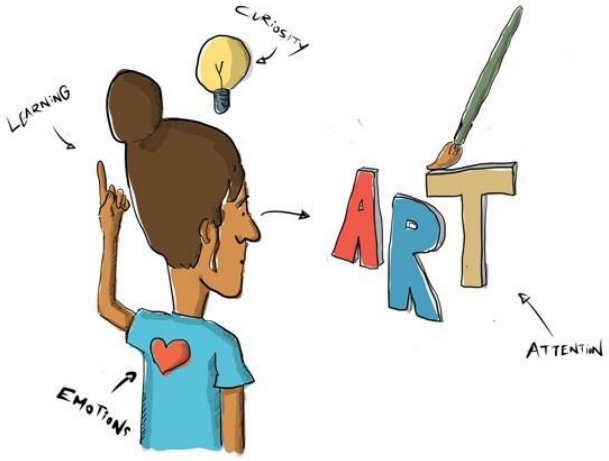


Figure 7: Advantages of art

The possibility to create a shared language through art is another important aspect in the context of sustainability and global challenges. Especially when using visuals as a main communication method, the "visual language [can] span all ages, cultures, and experience levels" (Rodríguez Estrada & Davis, 2015, p. 141), therefore addressing a much wider audience. This is also visible regarding the "much higher citation counts among peer-reviewed literature" (Murchie & Diomede, 2020, p.410, cited from Lee et al. 2018). A visual way of showing different perspectives can enhance understanding and empathy. This becomes especially relevant regarding global issues and a shared understanding in sustainability science. Some experts consider it as "arguably the most effective form of science communication" (Murchie & Diomede, 2020, p.410, cited from Ynnerman et al. 2018) especially when communicating to non-scientific audiences.

Visual design has the potential to support and enhance verbal research methods in cross-cultural settings (Rodríguez Estrada & Davis, 2015). They can be effective for improving scientific explanations and the comprehensibility of results to both scientific and non-scientific audiences (Frankel & DePace, 2014). Research projects incorporating visual methods to communicate research findings can lead to higher audience engagement by presenting serious and complex topics in a simplified and playful way (Bartlett, 2013). Regarding ethical considerations in science communication, arts-based methods might also play an important role. Danhofer (2018) states that using arts-based methods can have a strong influence on researchers' reflexivity, since the process of developing materials for the communication of the results can be complex and involves collaboration and reflection (Darnhofer, 2018). Moreover,

it can reinforce participants' engagement and facilitate transparency – all important elements to meet ethical considerations as discussed above (Darnhofer, 2018).

2.2.1. Art in the field of social ecological research

In the field of social-ecological science, arts-based methods have received attention particularly in the context of research on human-nature connectedness (HNC) (Muhr, 2020). HNC is defined as a concept composed of at least three dimensions, the “cognitive”, the “affective” and “experiential connection” between humans and nature (Muhr, 2020, pp. 249-250).

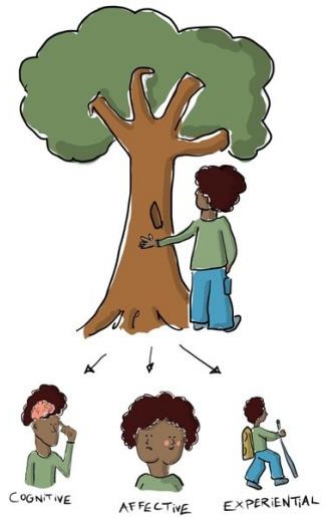


Figure 8: The dimensions of human-nature connectedness

The concept is based on emotions, beliefs or experiences, which are attributes that are often difficult to identify and analyze. Therefore, to better understand human-nature connectedness, there is a call for new and innovative methods that are not only based on language. The integration of arts-based methods alongside conventional research methods can improve research on HNC, since arts-based methods allow for example “to go beyond the verbal thinking mode and include a wider aspect of their experiences at the emotional level” (Muhr, 2020; Franklin, 2022, p. 267). In the field of social-ecological research, which the concept of HNC is embedded in, arts-based and other creative methods are becoming increasingly used to better understand relationships between humans and nature (Biggs et al., 2021). Social-ecological science, based on research on “social-ecological system” (SES), a concept that was developed in the mid-1990s for „understanding the intertwined nature of human and natural systems in this new, interconnected and interdependent way“, is an emerging field in the domain of sustainability science (Biggs et al., 2021, p.5). Social-ecological science focuses on

transdisciplinary ways of doing research including biophysical aspects as well as political, economic, social or cultural elements. The aim is to analyze the complexity of human and nature relations (Biggs et al., 2021).

Interactions worldwide lead to high complexity and multi-dimensional connectivity, with consequences on social and ecological levels. Anthropogenic pressures have consequences for earth and ecosystems, impacting human well-being and life for the future on the planet (Rockström et al., 2009). Through the recognition of the interconnectedness of social and ecological challenges, there has also been a shift in science on how to analyze and study social and natural systems. Due to its recent emergence and focus on high complexity, the methods used in social-ecological research vary substantially and the outcomes of the research are produced in a broader set than traditional disciplinary science (Biggs et al., 2021). But this also leads to a higher variety regarding research results, often marked by a large amount of qualitative data. Moreover, social-ecological science includes a diverse range of stakeholders involving diverse types of expertise, knowledge, which can also impact the heterogeneity of outcomes (Norström et al., 2020).

For social-ecological science communication, the use of arts-based and creative methods therefore holds great potential for communicating scientific findings (Biggs et al., 2021). According to Biggs et al. (2021) social ecological research can benefit from a focus on "creativity as a resource" since it can facilitate "knowledge co-production and engagement processes" (p.466). Since research on human and nature relations is always very complex and many different, rather non-traditional methods are used for knowledge generation, more creative approaches to communicate the diversity of results are needed (Muhr, 2020). Here, arts-based methods represent a creative way to break down complexity. Arts-based methods in social-ecological science communication can enhance understanding and sense-making of issues, and therefore initiate action, which can accelerate a shift in social perceptions (Franklin, 2022). Moreover, they "could serve to challenge the established rules, goals and underlying paradigm of (scientific) knowledge production" which according to Muhr (2020) is considered as a "deep leverage point for sustainability transformation" (p. 254). Therefore, for supporting societal transformation to sustainable living, there is a growing recognition among practitioners of the role of the arts especially in the context of communicating findings (Curtis et al., 2012; Moser & Dilling et al., 2009; Muhr, 2020).

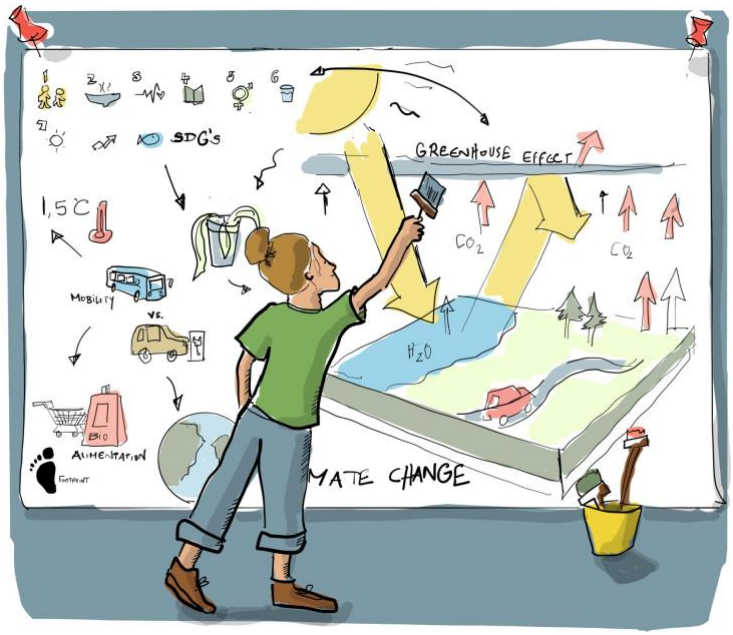


Figure 9: Arts-based methods in social-ecological science communication

2.2.2. Applying arts-based methods when returning findings

Having reviewed the justification of arts-based methods in science communication and its potentials in social and ecological science communication, the question of how they can be applied and what are important considerations arises. In the further text, materials for outreach are in focus, in particular posters and visualizations. How can they be produced and what aspects need to be considered? First of all, it must be recognized that visuals are based on the creativity and imagination of a person with a certain social, cultural background. Depending on the background, the understanding and interpretation of visuals can differ depending on experiences or values.

Figure 10: Bias of the artist in arts-based methods

This means that visuals need to be "constructed on a knowledge of visual perception, human cognition and behavior, and with consideration for the personal preferences, cognitive abilities and value systems of the audience" (Rodríguez Estrada & Davis, 2015, p.4). One way of ensuring that can be the involvement of the target group/s in the design process and using the method of a 'User-centered Design' (Frascara, 1997). This method developed in the context of communication design for social change, focuses through the whole process on the user of the design, including participation of users and multidisciplinary design solutions (Frascara, 1997). Therefore, a clear identification of the target group/s must first take place.

Estrada & Davis (2015) argue that science communication can become more effective if elements of the field of design are better incorporated. The opportunity to capture attention and convey information and messages quickly, can be affected by the "presentation layout, imagery, typeface, and color choice" (Murchie & Diomede, 2020, p.410). Therefore, it is important that visualizations or images that are used for outreach material need to correlate with text or surrounding content on the poster. 'Gestalt psychology' is often referenced when discussing visual presentation layout. A simplified explanation of 'Gestalt psychology' is that "individual elements in a visual presentation are not viewed in isolation, but are viewed together as a whole"(Murchie & Diomede, 2020, p.411). Thus, how objects are arranged in terms of "proximity, symmetry, and similarity" can have an impact on how the viewer perceives the design (Murchie & Diomede, 2020).

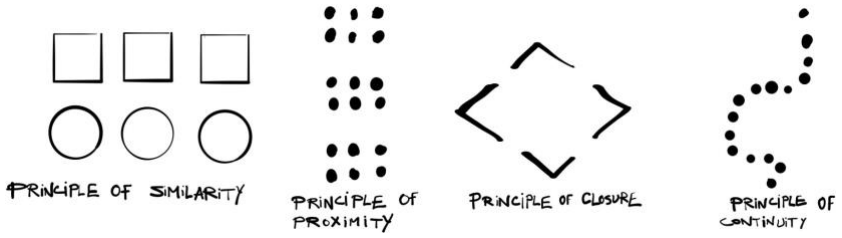


Figure 11: Four principles of 'Gestalt Psychology'

A closer look is needed for the poster creation for communicating scientific results. To begin with, the layout can affect the learning outcomes of the posters, since less cognitive work is necessary to progress information which is well laid-out (Cook, 2006). Instead of using stock images, the use of one's own photographs or self-created visuals and elements is recommended by experts. This can lead to more authentic outputs that can be easily adapted to the target group, with the possibility for the audience to have a more personalized experience and

connection to the information given (Murchie & Diomede, 2020). Moreover, font size and type are influencing legibility. Here, non-cursive fonts are considered as more readable (Murchie & Diomede, 2020). Regarding the choice of color, experts advise a maximum of three to five prominent colors. There are also color palettes that have been developed with the intention of being accessible to people who are colorblind representing a possible way for higher inclusion (Nichols, 2023). All in all, design elements such as layout, colors or fonts can navigate the viewer's experience, create a hierarchy of information and messages, and thus, should be taken into account when communicating science.

3. The case study

After reviewing the important aspects of developing outreach material, from ethical considerations to art-based visual methods, the context of the project in which they will be applied will be explained.

3.1. The research area: The Kilimanjaro national park in Tanzania

The Kilimanjaro national park represents an ideal case study area for social-ecological research due to its high level of biodiversity and variety of stakeholder groups present. The Kilimanjaro is a large stratovolcano located in Tanzania, in southeast Africa. It is located 300 km south of the equator and since 1987 designated as a UNESCO world heritage site. The National Park itself was established in 1973 and has a size of about 75,575 ha, (650 square kilometers) (UNESCO, 2012). The highest of the three volcanic peaks is the Kibo peak with 5895 meters above sea level. With that height, the Kilimanjaro is the highest freestanding mountain in the world. Kilimanjaro national park is protected under national legislation as a national park and the park is managed by the Tanzania national parks authority (Mount Kilimanjaro National Park, 2019).The mountain holds a high diversity of climate zones within a distance of only 30 km (Graw, 2019). The natural vegetation starts with the savannah zone between 700 to 1100 meters altitude. The submontane and lower montane zones with some coffee-banana plantations and different forest types vary between 1100 meters up to 1800 meters. Then there is the middle and upper montane zone between up to 2800 meters, followed by the highest elevation forests in Africa up to 4000 meters altitude. The alpine zones, starting at around 4000 meter altitude, are marked by subalpine heathlands and helichrysum vegetation and the upper alpine zones are mainly bare of vegetation (Hemp, 2006). The diversity of climate zones also

allows for a high biodiversity, with a range of different species, a huge variety of forest types, plants, and animals adapted to various environments (Graw, 2019; Hemp, 2006).

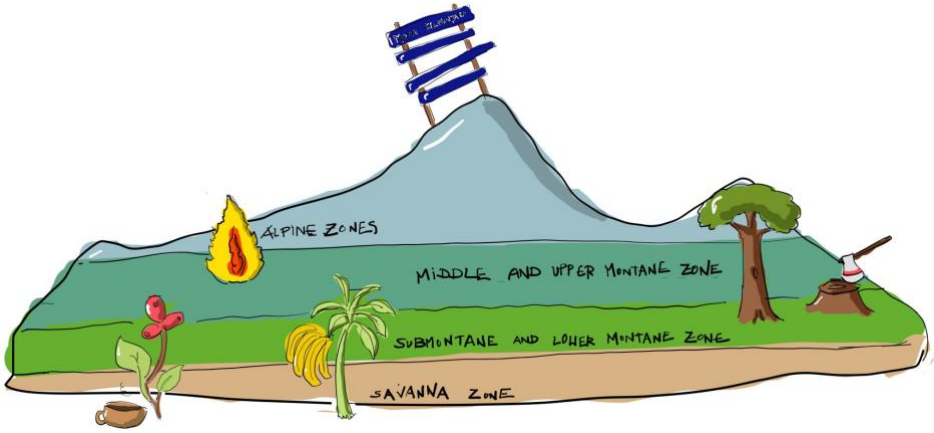


Figure 12: Kilimanjaro's climate zones

But in recent years, different factors have been posing a risk for the biodiversity of the region. Economic profit has led to land-use change. According to Cornejo et al., (2023) there has been an expansion of maize fields found in the former savannah areas. The lower montane is marked by agroforestry by the local population, on the one hand "intensive land-use system" like coffee plantations, on the other traditional 'Chagga homegardens' (different crop plants under remaining natural forest cover) which "represent a sustainable land-use model" (Cornejo et al., 2023, p.2). The middle montane forest zone is affected by deforestation, as well as the upper montane zone where anthropogenic fires and fires accelerated by climate change pose a high risk (Cornejo et al., 2023; UNESCO, 2012).

According to scientists from the department of tropical biology, land-use changes also affect the biodiversity of the region (Graw, 2019). The United Nations Educational, Scientific and Cultural Organization, states that not only land-use changes but also climate change poses a high risk for the Kilimanjaro (UNESCO, 2012). The risk of fires has increased, and glaciers are vulnerable to retreat. In 2012, UNESCO stated that "the impacts from these threats need to be closely monitored and minimized," calling for better management of human pressure in the area. Moreover, tourism is identified as another threat to the integrity of the mountain. A more sustainable infrastructure with better access regulation is needed as well as "education programs and integration of park management with all involved partners and stakeholders […]" according to UNESCO (2012, para. 6).

3.2. The research project “demands for and values of Nature‘s Contributions to People (NCP) at Kilimanjaro’s social-ecological system”

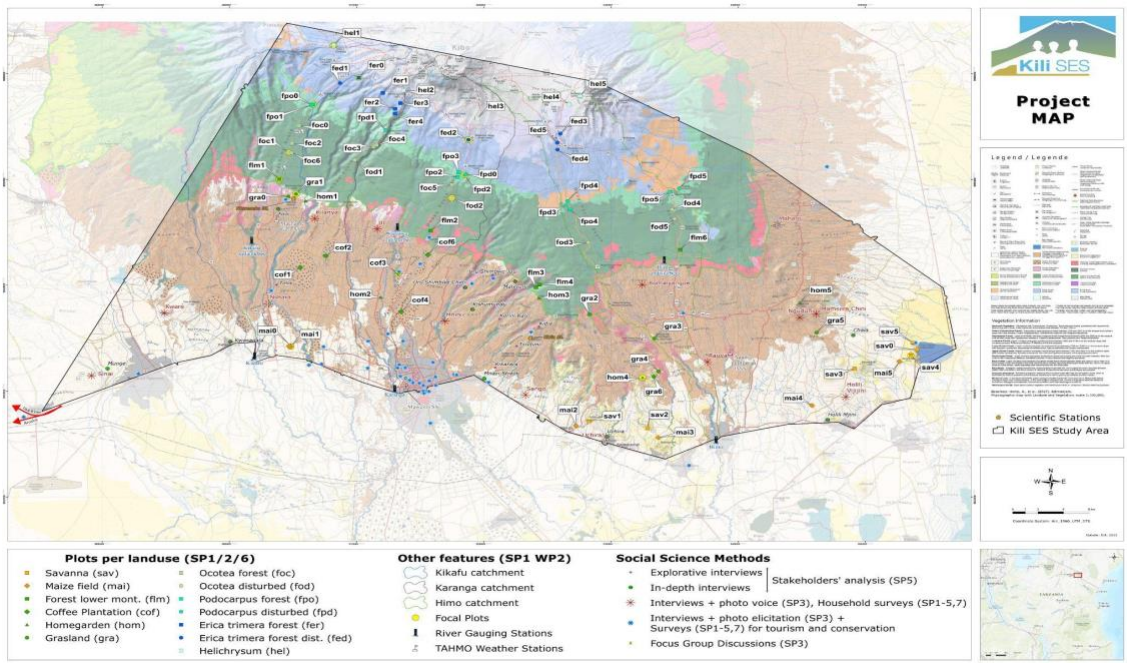


Figure 13: Kili-SES Project map

In the research project “the role of nature for human well-being in the Kilimanjaro social-ecological system”, in short Kili-SES, in around 65 research settings, nature‘s contributions to people are analyzed (Kili-SES, 2019). In the integrative social-ecological research approach, human and nature relations in the region are in focus. Next to NCP, components of biodiversity, human well-being, governance and indirect and direct anthropogenic drivers are relevant (Kili-SES, 2019). The project is working towards a “scientific base for decision-making and political processes” that aims at a sustainable way of governing and preserving the conservation of the nature reserve. The Kili-SES research project is divided into 7 subprojects. Different natural and social science methods are used for the data collection, for example interviews, surveys and social field experiments. The first two subprojects focus on biodiversity and its influence on the supply of regulating, material and non-material contributions to people. The third and fourth projects focus on the demands for and values of NCP and their impact on human well-being. Subprojects five and six investigate how anthropogenic drivers, like population increase or land management, influence biodiversity and also the role of governance and institutions as drivers of NCP supply and management. The last subproject represents a synthesis of the project (Kili-SES, 2019).

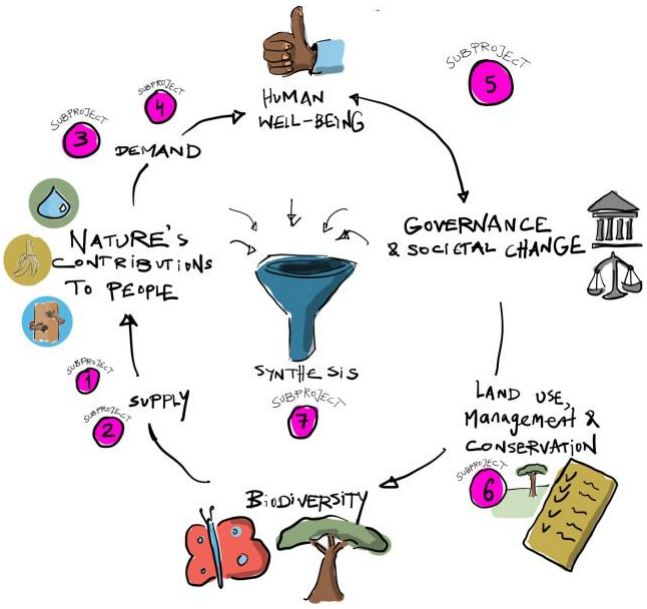
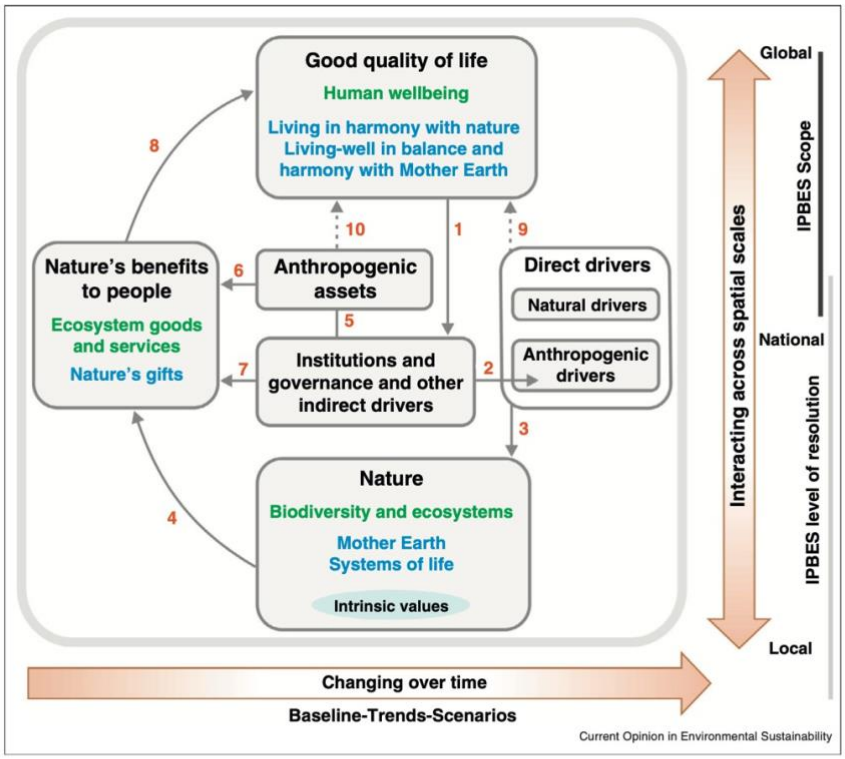


Figure 14: The subprojects of Kili-SES

The research of this thesis is part of subproject 3, which is focusing on the "demands for and values of Nature's Contributions to People (NCP) at Kilimanjaro's social-ecological system" (SESI, 2023). There are three specific objectives of the project. First to "unravel the demand for regulating, material and non-material beneficial NCP in the area and its trends" (SESI, 2023, para. 3). The second objective puts a special focus on the diverse non-monetary values of "regulating, material and non-material NCP expressed by the main stakeholder groups" (SESI, 2023, para. 3). The third objective looks at how local ecological knowledge from the Chagga community or local farmers influences the demands and values of contributions of nature (SESI, 2023). The Kili-SES research project is organized based on the guidelines of a framework of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The IPBES established a conceptual framework on how to do research in a transparent, participatory way, considering "diverse scientific disciplines, stakeholders and knowledge systems, including indigenous and local knowledge" (Dìaz et al., 2015, p.1).



The IPBES Conceptual Framework (CF). In the central panel, delimited in grey, boxes and arrows denote the elements of nature and society that are at the main focus of the Platform. In each of the boxes, the headlines in black are inclusive categories that should be intelligible and relevant to all stakeholders involved in IPBES and embrace the categories of western science (in green) and equivalent or similar categories according to other knowledge systems (in blue). The blue and green categories mentioned here are illustrative, not exhaustive, and are further explained in the main text. Solid arrows in the main panel denote influence between elements; the dotted arrows denote links that are acknowledged as important, but are not the main focus of the Platform. Links indicated by numbered arrow are described in the main text (section on Linkages among the elements, and Box 2). The anthropocentric values of nature are embedded in the nature, nature's benefits to people and good quality of life boxes, and in the arrows connecting them. The intrinsic values of nature (represented by a blue oval at the bottom of the nature box) are independent from human experience and thus do not participate in these arrows (see Values section in main text for detailed explanation). The thick coloured arrows below and to the right of the central panel indicate that the interactions between the elements change over time (horizontal bottom arrow) and occur at various scales in space (vertical arrow). The vertical lines to the right of the spatial scale arrow indicate that, although IPBES assessments will be at the supranational-subregional to global-geographical scales (scope), they will in part build on properties and relationships acting at finer — national and subnational-scales (resolution, in the sense of minimum discernible unit). The resolution line does not extend all the way to the global level because, due to the heterogenous and spatially aggregated nature of biodiversity, even the broadest global assessments will be most useful if they retain finer resolution. This figure, modified from Ref. [78], is a simplified version of that adopted by the Second Plenary of IPBES [84]; it retains all its essential elements but some of the detailed wording explaining each of the elements has been eliminated within the boxes to improve readability.

Figure 15: The IPBS Conceptual Framework (Dìaz et al., 2015, p. 5)

The goal of IPBES is to strengthen the connection between science and policy for a better conservation of biodiversity and ecosystems and their services to ensure long-term, sustainable outcomes. Its conceptual framework is a "highly simplified model of the complex interactions between the natural world and human societies that are most relevant to the IPBES goal" (Dìaz et al., 2015, p.3). One main focus is on the central role that institutions, governance and decision-making play in this context. Furthermore, the inclusion of different types of knowledge is targeted. On the one hand, western science and knowledge is present and on the other hand, the framework aims to include "diverse stakeholders (the scientific community, governments, international organizations, and civil society [...] and their different knowledge systems [...] local, indigenous, practitioners knowledge)" (Dìaz et al., 2015, p.3).

The conceptual framework is based on six elements which are representing natural and social systems. The six elements include “nature”, “nature‘s benefit to people”, “anthropogenic assets” (e.g. infrastructure, health facilities), “institutions and governance systems” and “other indirect drivers of change“ (e.g. how societies organize themselves and their interaction with nature) “direct drivers of change” (e.g. natural weather patterns, extreme weather events, volcanic eruptions) and “anthropogenic drivers” (results of human decisions) and “good quality of life” (defined as “highly value-based and context-dependent comprised of multiple factors) (Dìaz et al., 2015, pp. 4-7). Those elements can be “interlinked at various scales in time and space” (Dìaz et al., 2015, p.3). The concept of ‘Nature's Contribution to People’ was developed to get a better understanding of some of those elements and interlinkages. Here, the term ‘nature’ refers to “the natural world with an emphasis on the diversity of living organisms and their interactions among themselves and with their environment” (Diaz, 2015, p.4). The concept aims to better capture the diversity of values related to nature and its benefits for humans. Another baseline of the research project, in which this thesis is embedded, focused on the value system of different stakeholders connected to the area of the Kilimanjaro, as well as the contributions of nature to people and their well-being.

One dominant perspective on the value of nature is regarding its impact or benefit for human well being following the perspective that nature brings people “pleasure and satisfaction“, defined as instrumental value (Chan et al., 2016, p. 1462). Another perspective is the intrinsic value of nature, representing the viewpoint that nature exists for itself and is “independent of people” (Chan et al., 2016, p. 1462). In recent years, researchers also highlight “relational values”, which focus on relationships among people and between people and nature, presenting “values associated with good life“ (Chan et al., 2016, p. 1462).

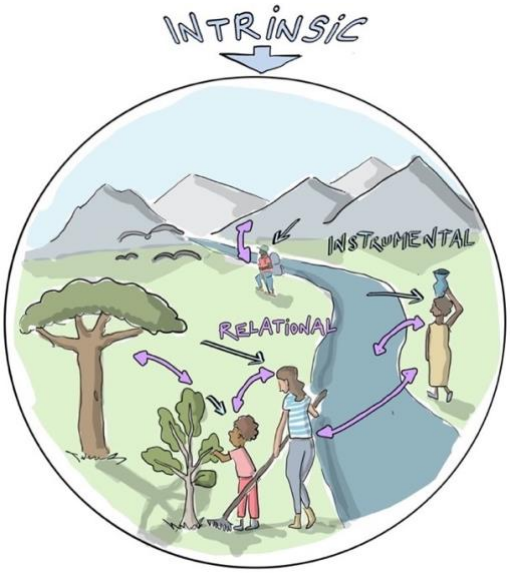


Figure 16: Intrinsic, instrumental and relational value of nature according to Dìaz et al., 2015, see appendix 3

To understand the value diversity held by different stakeholders, IPBES introduced the NCP concept, a more "inclusive approach to accounting for the diversity of values held by different stakeholders" (Christie et al., 2019, p.1267). There are 18 generalizing NCP categories clustered in three tight-connected groups: regulating, material and non-material NCP. Regulating NCP are concerned with the function of organisms and ecosystems, and are indirectly affecting people's quality of life. Examples for material NCP are elements that are directly part of people's world, for example the infrastructure they live in like energy, or materials for shelter (Díaz, 2018). Non-material contributions are "nature's impacts on subjective or psychological aspects underpinning people's quality of life, both individually and collectively" (Díaz, 2018, p.2).

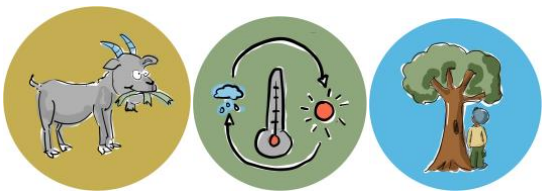


Figure 17: Examples of NCP categories: material (feed) , regulating (climate regulation) and non-material (learning)

4. Method

A literature review was conducted to gather knowledge about how to return research results to participants. Literature from various scientific domains were reviewed for background knowledge. The review was adapted to the context of the Kili-SES research project. Therefore one focus was put on literature about ethical considerations when doing research in a different culture. The other main center of attention was on literature about arts-based methods in the context of science communication and particularly on the use of visualizations for social-ecological communication.

4.1. The data collection

First of all, the data collection of the Kili-project, involving different methods, will be presented, to give an understanding of the content of the research findings. For the identification of the NCP valued and demanded by different stakeholders, semi-structured interviews were conducted. Before the whole data collection, participants were given information and consent forms informing them about the research project, intentions and aims, possible harms, risks and benefits (see consent form for FGD's in appendix 1). To identify the demands for NCP, the interviews included questions about the use and need of nature, its contribution to well-being and quality of life and other benefits, and the person's appreciation about Kilimanjaro's nature. Questions about the importance and the need for conservation of nature were asked to identify the stakeholders values for nature.

Another goal was to analyze the influence of local, ecological knowledge regarding demands for and values of NCP. In total 131 People were interviewed, consisting of 42 Chagga farmers and people from the local community, 38 former tourists, 20 tourist operators and 31 nature conservationists. Photo-elicitation was also used in some interviews, with participant consent, to gather photographs taken by interviewees of nature at Mt Kilimanjaro. The aim of this was to stimulate memories from participants and gain a deeper insight into how nature contributes to their lives. Once all interview data was transcribed and translated, content analysis was conducted of the interviews to identify a list of contributions of nature to people, including the generalizing NCP categories from IPBS as well as context-specific NCP. A second outcome was a list of values regarding nature and NCP in the area, also identified based on statements from interviewees.

The aim to include knowledge and perception, especially of women, was realized by two focus group discussions (FGDs). The first FGD took place in Maharo village, Rombo District (with 16 participants) and the second one in Nshara village, Hai District (17 participants), both within the Kilimanjaro region. To enable the inclusion of a variety of values and perspectives of Chagga women towards the nature around them as well as their relationship with it, participatory arts-based activities were used as methods. Those included drawings, paintings or small theater performances.

Figure 18: Photos from the focus group discussion with Chagga women

Furthermore, the method of photo-voice was conducted. The participants, Chagga people and local farmers, were asked to take pictures of the nature that they associate with being very memorable or beautiful or that they feel strongly connected to. Alongside, they were asked to record voice messages of that place. Next, a quantitative survey with around 600 participants was implemented. Participants had to select five contributions gained from nature at Kilimanjaro and rank them according to their importance for their life by giving points to each contribution. The method of semi-structured interviews was also used for analyzing the demand for and values of contributions of nature for Chagga and local communities as well as to find out if and how their local, ecological knowledge is influencing demands and values. All the

data from all different methods was analyzed, the surveys were analyzed with the software ‘RStudio’, data from interviews and FDGs with the software ‘MAXQDA’. The whole data collection and analysis was carried out by two PhD students, one postdoctoral researcher and the principal investigator of the project.

4.2. Returning research results

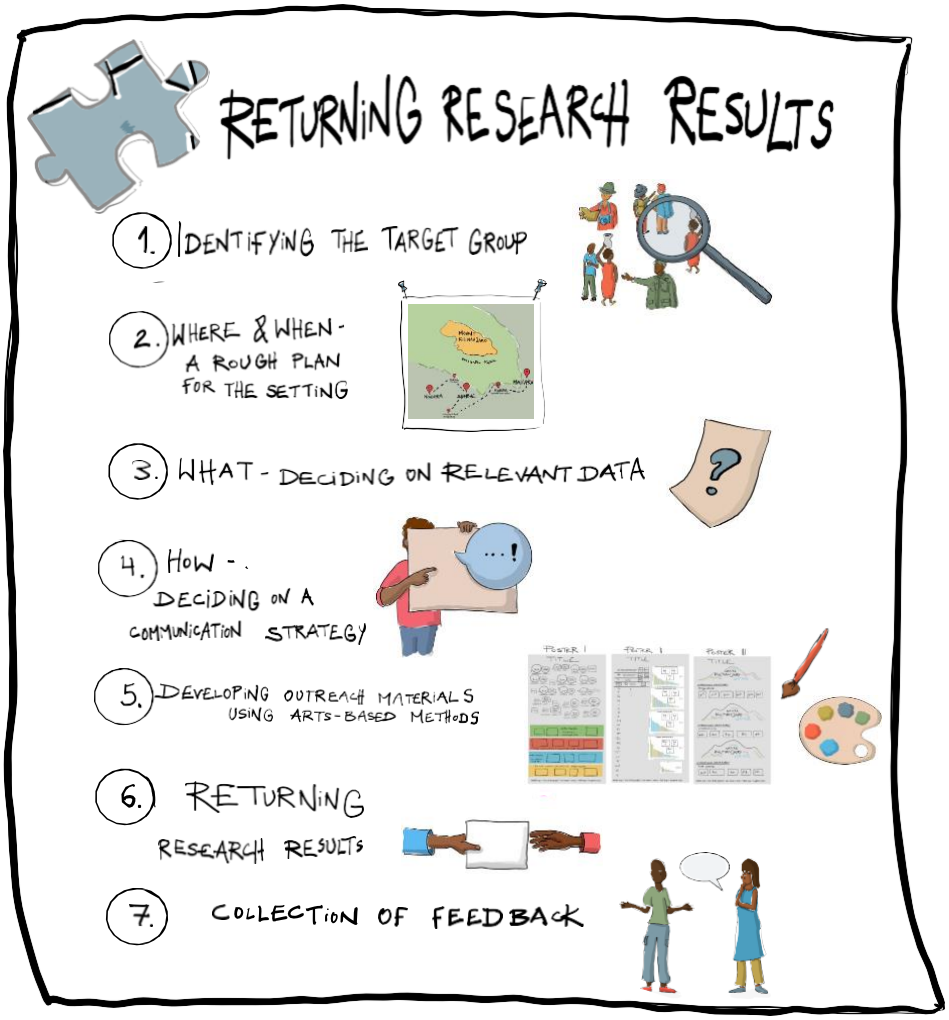


Figure 19: Steps for the return of research results

After the data analysis, the process of how research findings can be referred back to participants, started. In that context, the aspect of developing outreach material to show participants research findings will be in focus. Here, insights and findings from the literature review were important guidance and considerations.

4.2.1. Identifying the target group

Figure 20: Identifying the target audience

First of all, all stakeholder groups that were involved in the project were taken into account as target groups for the material. Those were ranging from Chagga people to nature conservationists, tourists and others. Moreover, sometimes the categorization of a participant into only one stakeholder group was not possible, since some groups are overlapping. A main focus was put on the Chagga communities and to design materials that are aiming to use their perspectives as reference points for developing materials. For that, essentials for the understanding of the materials from their perspectives needed to be considered. Having in mind the reviewed ethical considerations and guidance from anticolonial approaches of doing research, the involvement of participants was aimed for. Although there was no direct exchange with participants for the planning of material, a local perspective was gained through the Tanzanian PhD student of the research team who lives in the Kilimanjaro region. This helped to identify essentials to improve the understanding of findings. Here one main essential was to always make sure to have research results written in both Swahili and English.

4.2.2. Where and when- a rough plan for the tour-setting

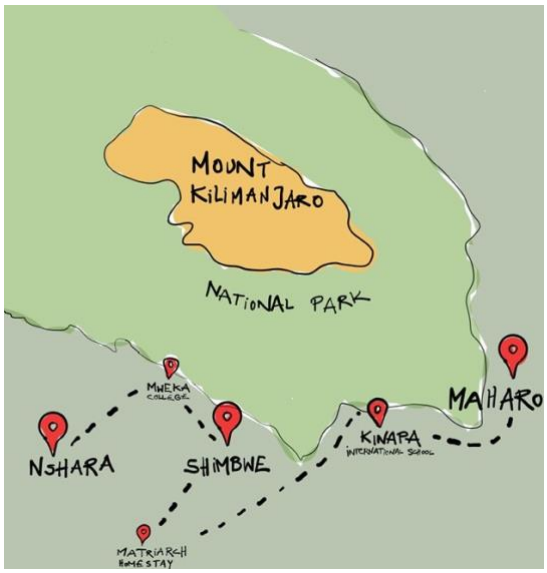


Figure 21: Destinations of the outreach tour

In a second step, the format and setting for returning the results was discussed. The format of an 'outreach tour', in this case a tour to the participants to make the research findings public to them and to present the results, was planned. This gave the possibility for direct exchange with participants. The research team sketched a route for the tour, deciding on when and where to present the findings, along with other organizational matters. Here a consultation with participants when they would be free was important to consider. Moreover, the availability of Tanzanian researchers to translate during the tour dates in person needed to be ensured. Since the outreach tour involved many different people, including the researchers themselves, a clear framework and plan for the outreach tour was essential. Therefore, in this step the questions of who, where and when were answered. Maharo, Nshara and Shimbwe were decided as main destinations to return research findings. Other destinations were KINAPA international school/ UWC, Mweka College and Matriarch Homestay. Moreover, deadlines were set when outreach materials needed to be finished. Here it was decided on a date for a first draft, a date for a meeting to discuss the draft and a deadline to complete changes and finalize materials.

4.2.3. What to return- deciding on relevant data

Figure 22: What to return

In a third step, the decision on what to return was discussed. Here participants' interests were put in the foreground. What can be considered interesting and important for participants? Moreover, given that, according to IPBS, social-ecological science works on strengthening policy for sustainable outcomes, it was also discussed if findings can be useful for participants from a policy point of view (Díaz, 2015). Relevant data that was decided on, included: first of all, a list of all NCP that were identified during the data collection. There were also more context-specific NCP categories explored, leading to a total of 25 NCP. Those included NCP-categories of regulating, material and non-material NCP, as well as the NCP-group "Intergenerational benefits" and an identification of the most important NCP per stakeholder group. Moreover, a table with quotes from diverse stakeholder groups with assigned values and NCP were included as well as results from the photo-voice, which were photos from stakeholders that they associated with specific statements, for example three photos associated with "an aspect of how nature contributes to your quality of life". Data on the most frequently occurring words in all interviews and focus group discussions were agreed on as relevant data. Those were broken down according to stakeholder groups and represented in word clouds created using NVivo software. In addition, many photos that are documenting the research process were also included as valuable parts for the materials.

4.2.4. How- deciding on a communication strategy

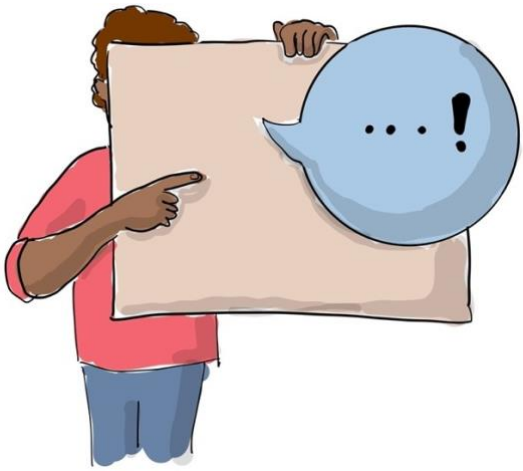


Figure 23:How- the communication strategy

The fourth step involved the decision on the communication strategy and the required resources for that, therefore the question of how to return the results. A poster presentation was chosen to communicate findings, which required materials that would support the understanding of the presentation. But it was also aimed at materials that could convey research findings by themselves. Therefore, prerequisites for the materials were that they need to be adapted to the social, cultural perspectives and literacy level of participants. Here, the use of art was considered as a good opportunity to reach those goals. Moreover, in the context of high complexity connected to social-ecological research and the variety of data that needed to be communicated, an arts-based way for communicating results was considered as useful. The use of art was also a fitting communication strategy in the context of the research project, since participatory arts-based activities were already used as a method of data collection and therefore participants were familiar with it. A0 posters with visualizations and graphic design as materials to support and communicate research results were agreed on.

4.2.5. Developing outreach material using arts-based methods

The fifth step was then the development of the materials. Firstly, a rough outline of all posters with their respective content was created, providing an overview.

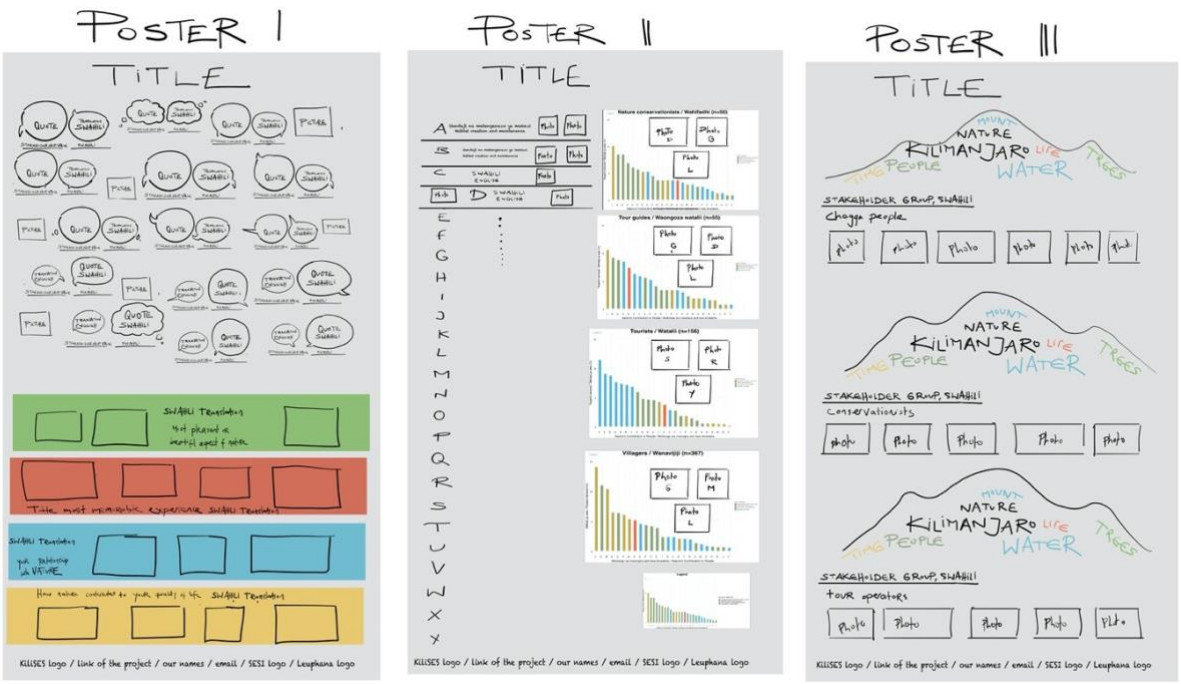


Figure 24: Overview of all posters and their respective content

Some essential content necessary on the posters included; names of the research team, and the responsible person for the design, the involved organizations and a link to find further information on the project. So in this step, the first focus was on ensuring information about the authors responsible for the scientific content and the possibility to inform oneself more about the project. The layout as the foundation was developed. 50 percent text, 30 percent design elements and 20 percent free space is a recommendation for scientific posters (Burkhard, 2017). Since the posters, designed for the outreach tour also include visual elements, the percentages are good guidelines but were not necessarily complied with. To make it easier to find the way around the posters, the reference points to the research team and the project were arranged in the same style in the bottom part of all posters.

Figure 25: Reference points to the research team and the project on each poster

Another important aspect was to leave enough space for translations of texts. Since the main target group speaks Swahili, that was chosen as the first language written down, followed by an English translation. The concept of 'Gestalt Psychology' was used as one guidance for the

layout and to connect images and visuals with text and data. For example the grouping of speech bubbles with the belonging stakeholder groups followed the principle of proximity, allowing to perceive elements that are placed close to each other, as a set or a group (Todorovic, 2008). Or using the same background shape for the NCP (on poster 2) using the principle of similarities, which states that humans tend to group elements in their visual fields by looking for similarities (Todorovic, 2008). Moreover, colors were an important tool to give an overview and guidance of the posters. Colors referring to different NPC-categories were used as the color code for the poster design. The commitment to five main colors made the posters more sorted.

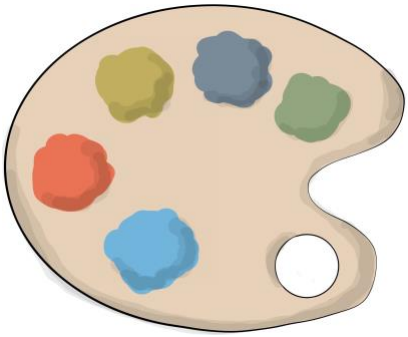


Figure 26: The Kili-Color code

They offered a tool to connect different information and therefore improve the communication. For example in the data analysis researchers analyzed that some NCP were more often found in certain stakeholder groups. Therefore, for example on poster 3, presenting word clouds of different stakeholder groups, the colors were not only chosen for a better overview, but for connecting the stakeholder group to NCP-categories. For example the stakeholder group Chagga people in the color of yellow standing for "material NCP", since this NCP-category was most often found for that group. Or the word cloud of the stakeholder group tourists in the color of blue indicates contributions of nature for people considered as "non-material". Different fonts and font sizes were used to create a hierarchy of the information. For a scientific DIN A0 poster, font sizes of at least 24 to ensure legibility also from a distance are recommended. The title was designed in a font size 100 ppi to draw attention. Moreover, fonts without serifs were used to increase readability (Burkhard, 2017). Graphic representations, considered as important means for improving explanations and understanding of scientific matters, were used to represent data and information on the posters (Frankel & DePace, 2012).

Figure 27: The stakeholder groups (from left to right) Chagga women and men, Chagga women, Nature conservationists, Tour guides, Tourists

The five stakeholder groups identified in the results – Chagga people, Chagga women, Nature conservationists, Tour guides and Tourists – were each transformed into an icon. Here, stereotypical images guided ideas for the icon of tourists or tour guides. For the icon for Chagga women, a painting that was developed during the research process by a local inspired the representation.

Figure 28: Paintings from a local painter developed during the FGDs

This also allowed for a way to aim at representing participants from a closer perspective to their own one. Photos were also good inspirations for the creations of icons, for example features like the traditional uniform of Nature conservationists were identified in photos. Icons were used throughout all posters to represent stakeholder groups. A goal was to assign stakeholders easily and without the necessity of language. Furthermore, icons were designed for the NCP-categories by visualizing them in a very simplified manner. This should allow for a quick understanding of each contribution of nature to people. “Canva” and “Adobe Fresco”

were important design apps for the development of graphic design, which were developed on an ipad. For poster 3 word clouds were chosen as a suitable format to show the words most frequently mentioned in interviews and focus group discussions. The app ‘Phoetic’ was used to design the word clouds. To symbolize the connection of the words with the Kilimanjaro, the shape of the word clouds resembles the shape of the mountain.

Important part of the development of the materials was also feedback on the materials within the research team. A meeting with the whole research team for the discussion of the first drafts was important to take all perspectives into account and thus mutually reinforcing creativity and creative ideas. The first versions of the posters (see appendix 4) were thus changed, adapted and the finalization of the posters required a couple of feedback meetings. The posters were saved as pdf formats to ensure a high quality. Then they were printed in A0 size.

Figure 29: The research team

4.2.6. Poster presentation and feedback of the outreach tour

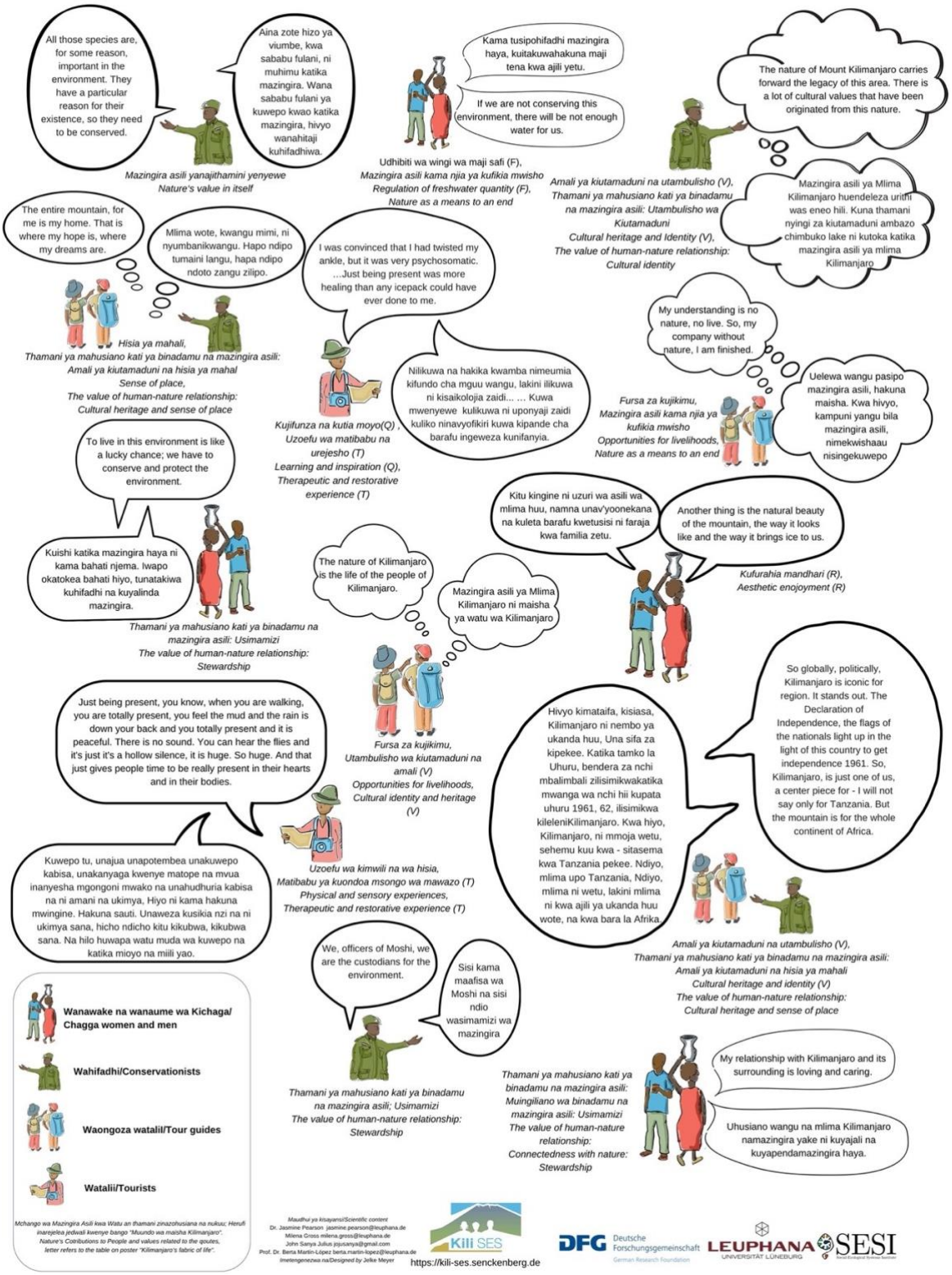
Research findings were returned by the research team. At the beginning of the outreach tour the research team discussed how to present the posters. They decided to start the presentation with an introduction of the research team and the project so that participants were reminded of the intentions and aims of the research project. The research findings were presented on the basis of the posters. The order of the poster presentation was introduced as well as the gathering and formation of the data behind each poster. Members of the research team or people from the community translated spoken explanations into Swahili.

Moreover, an important part of the outreach tour was collecting feedback to reflect the return of study findings. Participants were given the opportunity to provide feedback on the poster materials and how they were presented. This feedback was written down in the form of notes by the research team (see appendix 5). Moreover, general observations and reflections were also written down during or after each outreach tour event. The feedback was not audio-recorded since this requires ethical approval and compensation for participants, which were not obtained due to limited funds and time. By reviewing the collected feedback, the most interesting and frequent comments and questions were drawn out and a reflection of the posters was possible.

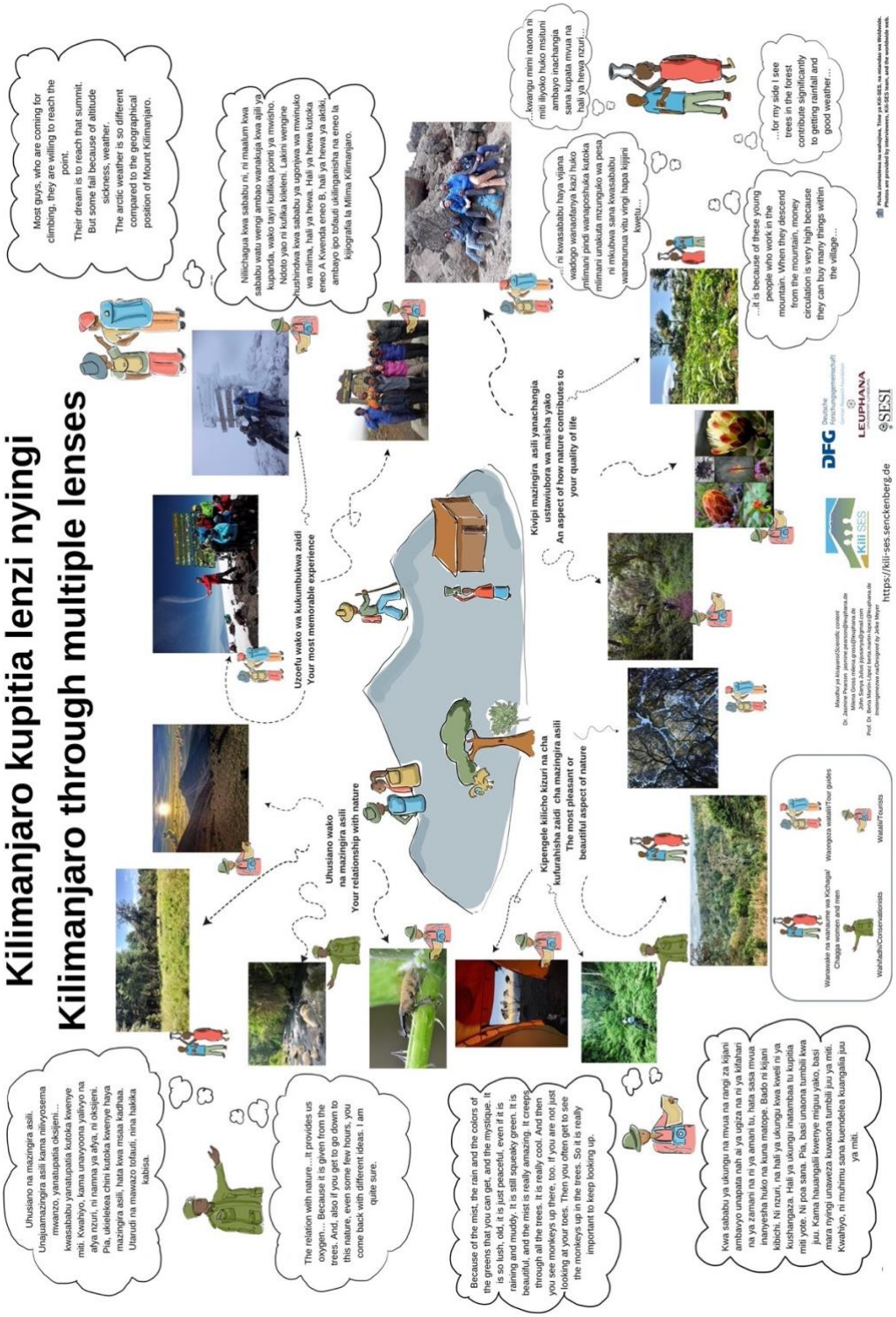
5. Results

5.1. The posters

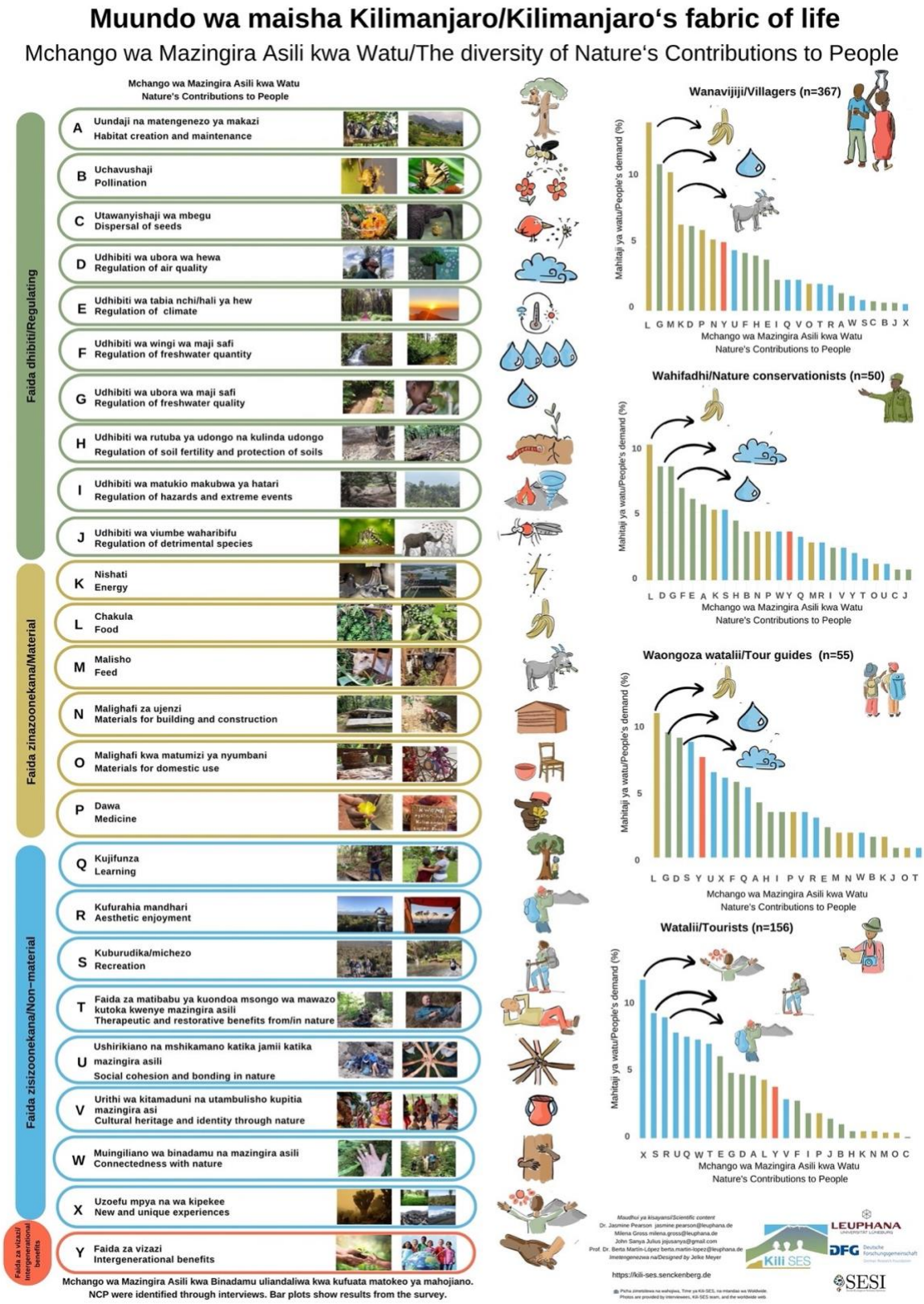
The main results of this thesis are the four posters presenting the research results of the subproject “demands for and values of Nature‘s Contributions to People at Kilimanjaro’s social-ecological System”.



Poster 1 “Sauti ya Kilimanjaro/ Voices of Kilimanjaro” summarizes significant statements from different stakeholder groups that were connected to a specific value as well as contributions of nature correlating to the statement.



Poster 2 “Kilimanjaro kupitia lenzi nyingi/ Kilimanjaro through multiple lenses” shows results from photo-voice data collection. Different categories were set by the researchers: ‘the relationship with nature’, ‘the most memorable experience’, ‘the most pleasant or beautiful aspect of nature’ and ‘an aspect of how nature contributes to the quality of life’. Participants contributed images that they associate with those statements in the area of Kilimanjaro.



Poster 3 “Muundo wa maisha Kilimanjaro/Kilimanjaro’s fabric of life” presents the diversity of nature’s contribution to people that were identified during the research project. Moreover, NCP are ranked according to their importance for each stakeholder group.

Poster 4 “Thamani ya Kilimanjaro kwa maneno/ The value of Kilimanjaro in words" shows word clouds representing the most frequently mentioned words associated with Kilimanjaro by each stakeholder group.

5.2. The use of the posters for the outreach tour

Figure 30: Presentation of the posters during the outreach tour

In total 151 people from different communities took part in the in total 7 outreach events.

Event	Number of participants / guests
Maharo	16
Nshara	16
Shimbwe	7
KINAPA	7
International School	44
Mweka College	41 in person and 7 online
Sophie's place	23
Total	151

Table 2: Number of participants/guests attending the outreach tour

5.3. Outreach tour feedback and Q&A

Figure 31: Photos from the outreach tour

During the feedback, various different questions and comments were raised by participants. Here the format of the outreach tour allowed the researchers to directly respond to questions, supporting the conveyance of key messages and avoiding misunderstanding. Some questions raised by the outreach tour attendees were about the research process. For example: "Where did you sample [in the villages]? How did you account for variability? How did you calculate your sample size[s]?" Another content-related question asked why the research team put a strong focus on Chagga women in the project? The answer to that was:

> "(...) for the focus group discussions we chose Chagga women like yourself because a) we wanted to give you a safe space where you can express your opinion freely and b) because we know you have an important role to play when it comes to nature at Mt Kilimanjaro, whether it is related to agricultural activities or taking care of the land".

Another question included: “Why is the research focusing strongly on nature?” Here researchers responded that the research was aiming at exploring human-nature relationships, not only focusing on nature, but on its contribution for people and how people value those.

Figure 32: Questions during the outreach tour

Moreover, questions came up on values from different stakeholder groups, or disadvantages of nature. After the presentation of the posters, issues and problems in the region or questions regarding recent fires and its origins in the Kilimanjaro region were also part of discussions, for example the KINAPA-community and their projects and the ‘half-mile issue’ (see appendix 5). Mostly positive feedback on the research project and the posters was received. Questions from the research team regarding the comprehensibility of the posters were asked to participants. Those included if information on the posters were meaningful and/or interesting to them and if they felt their values and the way nature contributes to their lives was represented well. All participants from “Maharo village" answered with yes (see appendix 5). Regarding the use of arts-based methods, participants stated that through colors and icons the comprehensibility of the content improved and that “it became clear that people, nature and biodiversity and the relationships and benefits between them were a main focus of the research”. To the question from the researchers if the posters made sense, one participant answered: “I like the color coordination of the NCP list and the graphs. The colors and icons help with the understanding. It is clear”. Many participants stated to be happy to be involved, feel appreciated and privileged (see appendix 5).

5. Discussion

The development of material for the return of research findings for the project came along with some challenges that allowed for important considerations when returning findings especially when including the use of art. First of all, arts-based methods offer the opportunity to generate attention, and suggest new approaches for understanding and interpretation. Therefore, they also carry a high power. This means, a constant reflection on one's own bias and perspective when creating material for participants, especially when societal, cultural background differs, is of high importance. Regarding research in other countries, considering the colonial history, the use of arts-based methods like visualizations needs to be used with even higher caution. How do people feel about being represented in for example comics form, given comics' close association with children and the long history of racist and sexist visual stereotypes. Therefore, particularly when doing research outside of one's own cultural milieus, it is vital that researchers are in dialogue with participants about styles of visual representation (Leavy, 2019).

In the context of the project, the exchange within the research team, or with people from or familiar with the research area, was a good way to better understand and approach perspectives from the target audience. This exchange included for example questions about colors Chagga People connect with nature, features nature conservationists have that can be used for representing them or changes in the design of the icons; like the icon for medicine that was changed into a flower, which is used as medicine in Chagga communities.

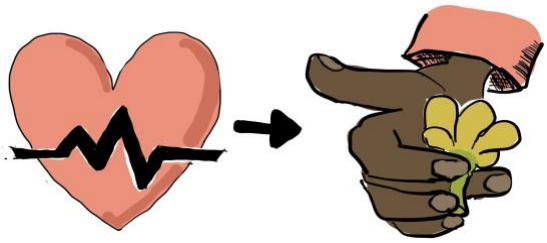


Figure 33: Icon medicine: before and after

Here another important aspect was to also have a local person, familiar with the cultural, societal background, look over the results again, to ensure the prevention of wrong translation, misleading graphics or representations. Moreover, the exchange and frequently obtained feedback within the research team was an important source for inspirations and new ideas for the design, as well as an important anchor point for constant reflection. At the same time, this

needed the ability to work with high adaptability and flexibility. For the development of the icons, a main challenge was the simplification and translation of written data into one visual. Here, several considerations came into play; first, the loss of content when reducing text into visuals (Murchie & Diomede, 2020). Then having in mind the own bias and perspective that influences ideas of the icons. As an example, trying to come up with icons for NCP like: ‘materials for domestic use’ or ‘medicine’, but not being familiar with the cultural setting and participants' realities of life, posed some questions. And moreover, the challenge of being confronted with the problem of reinforcing stereotypes. Since a ‘visual language’ is more accessible than written text, due to the elimination of language barriers, this also means a high power. So, for example, the risk of solidifying stereotypes if they are replicated again and again through a certain presentation. Especially the development of icons representing humans and stakeholders of the research project posed a challenge and can be critically discussed.

Figure 34: Challenges when using arts-based methods

To deal with these challenges, the exchange in the research team was again important. In addition, photos were helpful tools to find inspiration and to get a better understanding of the life situations of the participants. However, checking and exchanging information with people who know the research area was the most important way to deal with the challenges. Therefore, the fact that the research team of the project also consisted of researchers from Tanzania was important and helpful in dealing with the challenges. A possible improvement in this context

would have been a direct contact person from the participants, with whom a constant exchange would be possible in order to consider local perspectives and to have a better adaptation of visualization to the target audience. This would have been closer to a 'User-centered design' and might have allowed for more focus on an anti-colonial approach for the development of the materials, as participants would be more involved. At the same time, this would have also required more resources, for example translations. Questions that were asked during the outreach tour can also serve as indications for challenges regarding the communication. For example, more preciseness in the illustrations might have clarified a few questions already by itself. Or maybe there could have been more focus on the main content of the poster which might have gotten lost by the amount of representations and graphical design. Leading to another challenge of the development of the posters: to follow the principle of "less is more", deciding where are images and graphic elements suitable and when does too much content make it difficult to quickly understand the main messages of the material.

But during and after the outreach also a lot of benefits were revealed especially by feedback from participants. The visual design supported and underlined the data. Since colors and icons of the stakeholder groups were essential parts to understand the findings on the posters, the graphical design was not only used to illustrate written findings but for actually conveying content. As described in the feedback section, participants stated that the design helped to understand findings. All this represents how beneficial art can be for science communication. Trust-building, teamwork, shared knowledge and experiences between researchers and participants can be highlighted as positive outcomes of the return of research results. Moreover, the development of materials and the outreach tour was also accompanied by an examination of the procedure, methods of the project and a reflection of the entire project for the research team. Participants asked for copies of the posters to use them in educational contexts. This showed that the materials about the research findings were understood and appreciated by participants as they may even want to be used further.

With regard to the high complexity in social-ecological research, transforming findings into simpler terms but still conveying the main messages, was a key goal. Researchers state that it must be well matched to the communication goal and data type, but all in all "the appropriate use of visualizations can help achieve the communication goal for the return of research results." (NASEM, 2018, p.228). On the whole, this was also proven in the outreach tour. The icons and graphic elements were supportive to underline information and narrow down key

messages in a visual way. In the process, it was considered as a suitable method for social-ecological-science communication.

Figure 35: The posters during the outreach tour

6. Conclusion

Figure 36: Returning research results using arts-based methods

This thesis tried to analyze the use of arts-based methods for science communication and important considerations in the context of returning research results to participants. To sum up, it was worked out that arts-based methods hold a high potential to improve the return of research results to participants. To follow important ethical principles in the context of the return, such as respect for autonomy, non-maleficence or beneficence, a strong focus on participants and their perspectives especially when planning the return of research results is

necessary. This is where arts-based methods can come into play, since they can make data more accessible and understandable for participants. Due to the high ability to attract attention and its universal comprehensibility, arts-based methods come along with power. They need to be used with high caution and in an appropriate context. Especially in the context of science and research, people using arts-based methods need to be aware of this power; and therefore also the responsibility that comes with it. This responsibility includes ethical considerations especially when working in a different culture and societal setting.

To conclude, in the context of science communication with the use of arts-based methods, a reflexive way of doing research, being aware of one's own perspective and bias is the first necessity especially when creating graphical representations. Obtaining feedback regularly, exchanging with people familiar with the research area and in the best case with participants themselves to further increase participation, can avoid the reinforcement of stereotypes and represent a source for inspiration and reflection of one's own work. In social-ecological systems research, new and different approaches to address real-world-problems are used, questioning assumptions about our reality and how we study and shape it. With regards to social-ecological communication, arts-based methods can be very valuable because they represent a different way of research and moreover a creative way to break down and adapt to the complexity that needs to be communicated. In the context of the outreach tour of the project, the graphical representations and visualizations were useful elements to communicate findings about human-nature relations in the region of the Kilimanjaro. The success of the tour and the positive feedback shows the potential benefits of art in science communication.

Figure 37: Kilimanjaro's social-ecological system

This thesis is a first attempt to document the use of arts-based methods for communicating research findings back to participants in the context of social ecological research. In conclusion, art and creativity, used with caution and in a reflexive way, can be seen as really useful tools for effective social-ecological science communication, particularly when it comes to returning results to participants. In literature there is still a lack on documenting the process of returning research findings. In particular the use of arts-based methods for that part of the research is not considered. More research in this direction is needed, to further explore the possibilities of arts-based methods to improve science communication. And to put more focus on the improvement of the step of returning research results to participants by exploring important considerations and guidance, as well as the power of art in this context.

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8. Appendix

Appendix 1: Declaration of consent for the focus group discussions (FDG's) of Kili-SES

Emotions, values and human-nature relationships at Mount Kilimanjaro

We warmly invite you to participate in a focus group discussion (FGD) about emotions, values and human-nature relationships at Mount Kilimanjaro.

Investigators

This project is being undertaken by Dr Jasmine Pearson (Postdoctoral researcher) and Prof Berta Martin-Lopez (Principal Investigator) at Leuphana University Lüneburg. Please reach out to Jasmine if you have any questions about this project. Jasmine´s contact details are: jasmine.pearson@leuphana.de

What is involved?

This focus group discussion (FGD) will be held as a workshop with Chagga and local women who live on the southern slopes of Mt Kilimanjaro. The first part will be an individual drawing exercise to illustrate human-nature relationships. The second part will be a group-based exercise on emotions and beneficial contributions of different landscapes. The third part will be a group-based exercise about values of nature, expressed in different arts-based methods. The FGD will close with an open discussion at the end where you will have the opportunity to provide feedback or raise questions to the facilitators.

As a participant in this research, your participation is entirely voluntary. You are welcome to leave at any time if you do not feel comfortable being involved in this study. You may refuse to answer any questions you do not feel comfortable answering at any time. You must be 18 or older to participate in the study.

Confidentiality and anonymity

Your identity and information will *remain completely confidential and anonymous* so we can ensure that this is not revealed in any outcomes from this study. *If permitted*, the FGD will be recorded in order to preserve and analyse the information given which will be later translated. You are also free to ask any questions or raise any concerns you may have about this study at any time. You will also be able to stay in contact after this study has been completed to provide feedback or access the final outputs. Upon completion of this project, all data will be stored in a secure location (and destroyed after exceeding the legal retention period of 10 years).

What are the benefits of this project?

In the Mount Kilimanjaro region, competing land uses and impacts from climate change have led to a dramatic increase of the demand for nature. Understanding the emotions, values and relationships with nature held by local people is essential for the effective assessment and the sustainable management of nature. This project will provide much needed empirical data for policy- and decision-making at both international and national levels. On a personal level, you might benefit from the study by reflecting on your relationship with nature and making connections during the workshop.

What are the risks?

We do not foresee any risks with your participation in this research. However, we will aim to avoid any potential distress or discomfort by ensuring the following:

- avoidance of questions of a highly personal and sensitive nature;
- the option of participants to not discuss some aspects of the research; and
- the ability of participants to leave the FDG at any time with no need to give any reasons for such.

How can you access the findings of this study?

The findings/outcomes of this project will be published as peer-reviewed journal articles. We will also develop a short summary of the key findings/outcomes to send to participants who are interested.

Ethics

This study adheres to the guidelines of the ethical review process of the Ethical Review Board of Leuphana University. Whilst you are free to discuss your participation in this study with project staff (Jasmine Pearson is contactable on jasmine.pearson@leuphana.de), if you would like to speak to an officer of the University not involved in the study, you may contact the Ethics Board Secretariat: ethikbeirat@leuphana.de

DECLARATION OF CONSENT

I acknowledge that I have read and understood the information provided on this project. I hereby provide consent to be a participant in this focus group discussion (FGD) as part of this research project on nature´s contributions to people in the Mt Kilimanjaro region.

- I have received clear and concise information, both written and verbal, about this research, and I understand what is required of me during the FGD.
- I acknowledge that my participation is entirely voluntary and that I am able to leave the FGD at any time or refuse to answer any questions without any explanation or penalty.
- *If permitted* (see tick box below), I acknowledge that the FGD will take place in person and a recording device will be used to record the FGD and be later transcribed.
- *If permitted* (see tick box below), I acknowledge that photos and videos will be taken during the FDG to be used in scientific outputs / presentations.
- All information related to this study will be securely stored.
- I acknowledge that my identifying information will remain confidential and will not be used in any publications or other outlets.
- I acknowledge that I am able to make contact with the persons involved in this study in order to seek any information about the current and future use of this research and to raise any concerns if necessary.

Please indicate if you consent to the following:

☐ I consent to parts of the FGD being audio-recorded, and later transcribed.

☐ I consent to photos and videos being taken during the FDG.

☐ I consent to photos and videos to be used in scientific outputs, presentations and outreach material.

We appreciate your participation and thank you for contributing to scientific research. If you would like to receive a summary of the results, please write your email address below:

……..

Participant's Name……..……

Participant's Signature ……..……

Date……..…….……..

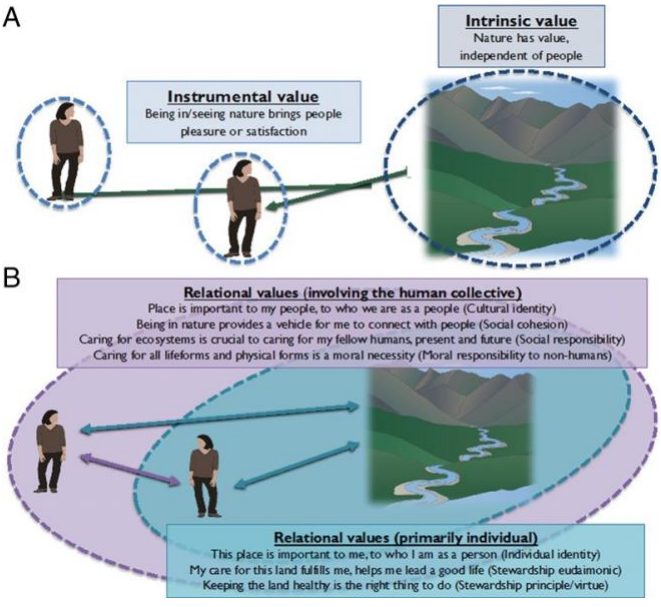
Appendix 2: Ethical principles for scientific research according to Weinbaum et al., 2019, p.6

Ethical Principles for Scientific Research

Ethical Principle	Definition
Duty to society	Researchers and research must contribute to the well-being of society.
Beneficence	Researchers should have the welfare of the research participant in mind as a goal and strive for the benefits of the research to outweigh the risks.
Conflict of interest	Researchers should minimize financial and other influences on their research and on research participants that could bias research results. Conflict of interest is more frequently directed at the researcher, but it may also involve the research participants if they are provided with a financial or nonfinancial incentive to participate.
Informed consent	All research participants must voluntarily agree to participate in research, without pressure from financial gain or other coercion, and their agreement must include an understanding of the research and its risks. When participants are unable to consent or when vulnerable groups are involved in research, specific actions must be taken by researchers and their institutions to protect the participants.
Integrity	Researchers should demonstrate honesty and truthfulness. They should not fabricate data, falsify results, or omit relevant data. They should report findings fully, minimize or eliminate bias in their methods, and disclose underlying assumptions.
Nondiscrimination	Researchers should minimize attempts to reduce the benefits of research on specific groups and to deny benefits from other groups.
Nonexploitation	Researchers should not exploit or take unfair advantage of research participants.
Privacy and confidentiality	Privacy: Research participants have the right to control access to their personal information and to their bodies in the collection of biological specimens. Participants may control how others see, touch, or obtain their information. Confidentiality: Researchers will protect the private information provided by participants from release. Confidentiality is an extension of the concept of privacy; it refers to the participant's understanding of, and agreement to, the ways identifiable information will be stored and shared.
Professional competence	Researchers should engage only in work that they are qualified to perform, while also participating in training and betterment programs with the intent of improving their skill sets. This concept includes how researchers choose research methods, statistical methods, and sample sizes that are appropriate and would not cause misleading results.
Professional discipline	Researchers should engage in ethical research and help other researchers engage in ethical research by promulgating ethical behaviors through practice, publishing and communicating, mentoring and teaching, and other activities.

NOTE: *Research participant* refers to someone with an active role participating in research, whereas *research subject* could include someone whose data are used but who does not consent to participate.

Appendix 3: Types of values according to Dìaz et al., 2015



The difference between the instrumental and intrinsic value framings that dominate environmental literatures and relational values. Whereas intrinsic values (A) pertain only to the value inherent in an object, and instrumental values (A) pertain to the value of the object for a person, relational values (B) pertain to all manner of relationships between people and nature, including relationships that are between people but involve nature (e.g., a relationship of impact via pollution, which is mediated by a watershed).

Appendix 3: Outreach tour feedback, Q&A and observations

Outreach tour feedback, Q&A and observations

1. Maharo village

Participant observation:

The women are looking through the posters and discussing together. One woman (a teacher) is explaining the words in the word clouds and connecting them to other words to tell a story. E.g. the **mountain** has **trees** and the **trees** provide **water** and **water** is used for **farming.** Now she is going through the NCP list to explain the most prioritised NCPs to the other women.

Question 1: I have noticed that nature at Mount Kilimanjaro seems to be the key theme here. Why do you focus on nature? Why do you want to tell us about nature?

- Jasmine response: our research aim was to understand how people value nature and its contributions to people at Mount Kilimanjaro. Mount Kilimanjaro was chosen as a study site because it is a unique biodiversity hotspot with many different actors relying on nature and also many threats from competing land uses, tourism, climate change etc.
- Milena response: we want to understand human-nature relationships at Mount Kilimanjaro, not just nature.

Question 2: What does regulation of detrimental species mean? Does it refer to people killing monkeys?

- Jasmine response: it does not refer to humans regulating detrimental species, but rather non-human entities.
- John provides examples of weather conditions and mosquitos, and bee regulation of elephants.

Question 3: What does therapeutic and restorative experiences refer to?

- Jasmine response: this NCP mostly came up during interviews and other methods with tourists, but also some other actors. It refers to nature´s ability to put one´s mind at ease, to help us feel relaxed and reduce stress. It also refers to nature´s role in emotional healing.

Comment: Thank you for this information and congratulations to the team. We can use this for capacity building.

Jasmine´s questions:

- ***Do the posters make sense?***
  Answer 1: if you look clearly, the posters are talking about the same issues: people, nature, biodiversity, relationships and benefits.
  Answer 2: I like the colour coordination of the NCP list and the graphs. The colours and icons help with the understanding. It is clear.
  Answer 3: It is a learning process. Everyone clapped for me because I explained the posters to the other women, but actually it was a group effort.
- ***Is the information on the posters meaningful and interesting?*** all women say YES
- ***Do you feel that your values and the way nature contributes to your lives are represented well?*** all women say YES

2. Nshara village

Participant observation:

The village leader asked if we could explain everything in the poster for them rather than them getting up to look at the posters themselves. We compromised with them by asking them to get up and take a closer look, but John will explain everything in Swahili.

Comment 1: I feel appreciation. Today I have learnt a lot through the pictures. I have not been to class in a long time but it felt like going to class again. I appreciate the photos.

Comment 2: I feel happy to see the different areas and to see nature in the posters. I am happy to see how the women, KINAPA and different groups describe the mountain and also to see the benefits listed such as air quality and water.

Comment 3: I feel happy that John explained rather than us passing through to look at the posters. I am also happy to be at the slopes of Mt Kilimanjaro so I can get the benefits of water, food etc. If I knew we were getting so much information, I would have invited others. I feel very privileged to be here – other areas have high flooding but we do not experience that here due to nature e.g. trees.

Comment 4: We can use this information for capacity building and training. Now we can use this information to plant trees and conserve nature because now we see the benefits of the trees, for example.

Comment 5: I am happy to be here and I appreciate what we have done. I did not know this was the result of the FGD in October. There is a lot of information I did not know before and now I can pass this onto others.

Question/comment: I am happy that I have understood the posters but why did you choose women?

- Jasmine response: we will also present this information to both women and men. But for the FGDs , we chose Chagga women like yourself because a) we wanted to give you a safe space where you can express your opinion freely and b) because we know you have an important role to play when it comes to nature at Mt Kilimanjaro, whether it is related to agricultural activities or taking care of the land

4. KINAPA

General discussion / participant observation: KINAPA were very interested in the NCP list / survey poster. They asked Milena to explain more of the NCP results (not just the top 3 per stakeholder). After the poster presentation, KINAPA explains their community projects and the half mile issue. During the 10 years of the half mile, Chagga women were taking firewood to sell to further away communities and schools. We have a project that provides firewood and resources to schools around the park. There are also other initiatives we fund such as mushroom cultivation projects, alternative charcoal (from maize), modern avocado seedlings, and youth programmes (we have 7 youth groups and we train them so that they don´t have to drink Mbege all the time).There is a lot of bureaucracy that happens between KINAPA and the Tanzanian government, so we can´t direct the money straight into communities. Sometimes people would go up further past the half mile to collect firewood if there was no deadwood left in the half mile.

Questions:

- **Question:** Why do only tourists mention experience? **Answer:** for tourists, it is about therapeutic and restorative experience, new and unique experiences. But for locals, it is their daily life, their basic needs.
- **Question**: Why did Chagga women mention firewood if they can´t go into the national park? **Answer:** for the women, the firewood could have been collected from outside the park since we refer to nature of the whole mountain. They need the firewood for cooking.
- **Question**: what have our neighbours been saying about us? **Answer:** the perspectives vary from village to village, but also within each village. Some appreciate what KINAPA is doing, and some complain because the forest has been taken away from us.
- **Question**: why did soil come up in the Chagga interviews? **Answer:** John explains that Chagga and local people were asked about soil, water and farming management practices. They talked about soil fertility.
- **Question**: You have talked a lot about the advantages, but not so much on the disadvantages of nature. What are the disadvantages of nature? **Answer:** John responds about the elephants and monkeys damaging assets and peoples.
- **Question**: because you do research, you need to return results and feedback back to people so that they can understand. You will write the report. What is your plan for this? **Answer:** Berta says this is what we are doing now for the outbreak tour.
-

Feedback:

- I am seeing how villagers appreciate the forest because they still depend on the forest with their needs such as food, feed and water. Even though they are restricted, this is the big challenge they are facing and they are struggling. Even though we impose these rules and regulations, we appreciate that the nature of the mountain still benefits communities.
- Berta asks if KINAPA thinks this feedback/information during the outreach tour is enough for them? **KINAPA response:** I think this feedback is enough for us, but not for villagers. Berta and John: the villagers also requested to keep a copy of the posters so they could educate their community members, so we think they appreciate.
- **KINAPA response:** another KINAPA member says that the posters would be suitable for educating and disseminating information to community members.
- Thank you for coming here and sharing your information with us. You are welcome again.

International School

One participant was grateful for seeing the connection between nature and quality of life.
A second participant was thankful for the eye-opening event and requested to hold hands with Milena.
Further questions were content-related.

- Where is the spiritual value of Mt Kilimanjaro?
- What's the origin of the project and its next steps?
- How do people perceive the trends of NCP, are they pessimistic or optimistic?
- What is the origin of fires, like the one happening in November 22?
- How many people live inside the National park?

- Comment on concern about activities within the national park
- Concern about the potato croplands
- What is our dream for our project's impact in 10 years?
- Comment to make Kili as a brandt for Quality of Life.

Mweka college

Participants did not mention any feedback on the outreach material; questions were content-related.

- Why do villagers prefer food? Do villagers demand food for their own use and/or to sell food? What is the monetary value of food? Do villagers demand food because of the monetary / economic value?
- What's the geographical definition of Kilimanjaro? Which area is covered by the project? Which area do people refer to? E.g., do people refer to the trees inside or outside (home gardens or plantations) the National Park?
- Where did you sample (in the villages)? How did you account for variability? How did you calculate your sample size(s)?
- Did you also consider socio-demographics or other traits, e.g., level of education? The level of education might influence the responses of the respondents (e.g., highly educated people might be able to reflect versus less educated people might repeat what they learnt in school).
- Which values underline NCP demand?
- The stakeholder groups might overlap. A tour guide might also be a villager. How did you define the stakeholder group? How did you consider hybrid people?
- Did you also study negative / detrimental NCP? Did you also study human impact on nature?
- Did you study sacred areas, sacredness, spirituality and their influence on NCP demand? And did you study the NCP of sacredness and spirituality?
- Did you study the influence of ethnicity and age on NCP demand?

Event	**Number of participants / guests**
Maharo	16
Nshara	16
Shimbwe	7
KINAPA	7
International School	44
Mweka College	41 in person and 7 online
Sophie's place	23
Total	**151**

Appendix 4: Photos from the outreach tour
(from top to bottom: KINAPA HQ, Sophie's in Moshi, Nshara, Nhara, Maharo)


Kilimanjaro kupitia lenzi nyingi
Kilimanjaro through multiple lenses

9. Declaration of authorship

I hereby declare that I am the sole author of this bachelor thesis and that I have not used any sources other than those listed in the references. I further declare that I have not submitted this thesis at any other institution in order to obtain a degree. I am aware of the University's regulations concerning plagiarism.

Lüneburg, 03. April 2023

Place, date

Signature