Designing a collective prototype of future (sub)tropical science

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Introduction

What does the future hold for (sub)tropical ecologists when present circumstances seem to rapidly dismantle their opportunities? Especially for early career researchers (ECRs), the current academic culture seems to disfavour ecologists coming from certain countries on the peer review process, the recognition of their research products and academic labour, lack of leadership opportunities in global settings (Amano et al., 2023; Fox et al., 2023; Maas et al., 2021; Ocampo-Ariza et al., 2023; Smith et al., 2023). Coming from a (sub)tropical region (broadly defined as countries in and around the Tropics of Cancer and Capricorn) and being at an early career stage is a very particular experience, with unique challenges and opportunities – and so is being an ECR from any other region. However, we often witness deliberate obfuscation of (sub)tropical ecologists on matters pertaining their own communities (Ocampo-Ariza et al., 2023), and we believe that putting these researchers at the centre of the discussion on the practice of tropical science is urgent. Breaking barriers for ECRs from non-European and non-North American countries to lead and contribute meaningfully to their own communities will be decisive to revamp academic culture (Kent et al., 2022), as well as to bring the necessary change to public policies affecting local ecosystems.

This paper is based on an interactive session held at a conference in 2021 (Higino et al., 2021). By that time, we were about 18 months into the COVID-19 pandemic, which highly impacted the scientific career of ECRs (Corlett et al., 2020; Lokhtina et al., 2022; Schadeberg et al., 2022). In this context, we aimed at using speculative story making to outline our wishes for the future of (sub)tropical ecological research (Box 1; Supplementary Information). Here we expand on the story that we wrote together and frame our wishes for inclusion of, and collaboration with, ECRs from (sub)tropical regions as three different facets based on who has

the power to effect change (Figure 1). We outline "aspects" that affect opportunities for (sub)tropical researchers, starting with social spheres outside academia (focusing on governments and policies), followed by academic and adjacent institutions, and finally, personal attitudes of researchers and the community. With that, we acknowledge that shaping the future of (sub)tropical ecology is dependent on (and should be addressed at) multi-scale efforts.

We chose to not define the term "ECR", so we don't exclude people that fall within the limits of a definition, and because we understand that different life histories shape our work as scientists in a way that is not always reflected in the amount of time we have in this profession. Also, we considered (sub)tropical ecologists as those professionals who were born, raised and/or professionally trained in a (sub)tropical country. We avoid using terms such as "global north" and "global south" as they are vague and might mislead the understanding of the context of our arguments. For us, the ecosystem where we live plays a fundamental role in this discussion, as they are frequently targeted in parachute research (Bhaumik, 2023; Miller et al., n.d.; Mwampamba et al., 2022; Odeny and Bosurgi, 2022), and the ones that will be most affected by climate change (Beaumont et al., 2011; Lenton et al., 2023), but are also the ones that are rarely benefited by the outcomes of the research produced there (Asase et al., 2022; Odeny and Bosurgi, 2022).

This team of authors is composed of researchers pursuing or who have recently earned a PhD degree, who are citizens of six different countries in South America, Africa and Asia, but currently working in North America and Europe. This discussion stems from our lived experiences of learning and practising science in our home countries and making (and being afforded) the choice to move for education and professional opportunities. Therefore, we are not exempt from biases and this paper should be read as a collective affirmation, not as scientific

evidence supporting a specific way of change. Nevertheless, we do aim at sparking a discussion and creating awareness about the barriers faced by ECRs from (sub)tropical countries so that all early career researchers can work together in a fair and equitable manner.

1. Public policies make research possible

Research in (sub)tropical regions is often funded and executed by foreign institutions, who then retain control over the production and diffusion of new scientific knowledge (Fabbri et al., 2018; Miller et al., n.d.; Qin et al., 2022; Raja et al., 2021; Trisos et al., 2021). As local funding is limited and competing for international grants might be difficult (especially in a foreign language), funding then becomes a key barrier in developing innovative research due to its impacts on study design (*e.g.*, equipment, sample size, replicates). This issue influences ECRs decision to pursue a scientific career abroad. Additionally, history has shown that data collected in the (sub)tropics is held in places far from their origin (*e.g.* species specimens in European natural history museums from the exploration of territories outside of Europe), and even today this seems to be true (albeit in a different form) (Asase et al., 2022; Cisneros et al., 2022). Consequently, where data repositories are held, who holds the right to these data and what is needed to access them, are barriers that deter (sub)tropical ECRs from staying "at home" in favour of seeking professional training opportunities abroad (Asase et al., 2022; Maas et al., 2021).

To counteract the imbalance in access to funding and resources across the globe, a partnership among international institutions is key. Foreign-aid agencies aiming to invest in research in the (sub)tropics could either partner with their local counterparts to design joint funding packages or make funding contingent on partnerships with local academic institutions. Furthermore, this funding would not require researchers to move abroad, and complete support

should be provided for them and their families if moving is an option. International collaborations are key factors in the professional development of scientists, combining mutual assistance in equipment, research permits and familiarity with the study system. They also ease resource access restrictions and promote opportunities for researchers from under-represented areas to gain exposure. This will ultimately result in higher chances for funding for local researchers. Enhancing the combination of different skills, cross-pollination of ideas, division of labour, and pooling of resources generates economies of scale in research activity by increasing the quantity and improving the quality of publications. Collaborations, therefore, create enabling environments for Research and Innovation (R&I) and foster capacity building.

Another societal barrier is local public support for research efforts, which is crucial to pushing conservation issues into the public agenda. Successful conservation science is achieved when findings can actively foster and lead to science-based decision-making (Winterfeldt, 2013). This success, therefore, depends on the access to scientific outputs to be universal, and intentional efforts to be made to disseminate understanding in the country where the research was conducted, such as multi-language abstracts, and partnerships with local press. Funding systems or national programs could then set conditions or deliver rewards, respectively, for community engagement and public access to publications. We believe that a strong collaborative world and large participatory projects involving both the private and public sector, and other community members are critical to overcoming these barriers and preventing the brain drain we witness in most (sub)tropical countries.

When it comes to public policy and ECRs, a very urgent topic is immigration and temporary visas. The exchange of students and researchers is very much delayed and restricted by global policies and temporary measures, which are very imbalanced against (sub)tropical

countries. For example, while citizens from countries like Japan, Germany, Italy, Spain, Sweden, France, the United States and Canada are allowed to enter >185 countries and territories without a visa, the majority of African citizens can only access less than 70 countries without a visa (Henley & Partners, 2023). The process of getting a visa usually takes a lot of time and money, while also requiring, very often, a high level of fluency in another language, enough to argue in legal terms with an immigrant officer. Avoiding hosting conferences in restrictive countries (while also considering people's safety regarding their identities), allowing, or encouraging remote work and providing extensive support to students and researchers navigating immigration processes are essential practices in Academia to nurture a better future, where immigration will become the norm to most of the people living in tropical countries (Lenton et al., 2023).

Notwithstanding, (sub)tropical countries have good policies in place that have the potential to foster two-way collaboration between them and non-(sub)tropical countries. For example, in Brazil graduate students usually get paid a salary by the government and don't need to pay tuitions. This is a potential benefit for international collaboration because these costs would not need to be covered, and instead the budget could be reallocated to research logistics or professional improvement of the researcher. Another example is how decision-making in many countries does not exclude non-English literature, in opposition to the very low representation of non-English literature in international biodiversity reports (Amano et al., 2023). A quarter of report authors said they struggled with English literature, showing English barriers to the uptake of evidence in decision making. However, half of them said having non-English titles or abstracts can help them search and understand English papers. These findings point to the importance of diversifying the scientific literature for making the best available evidence

accessible to anyone regardless of the publication language, and achieving Target 21 of the Kunming-Montreal Global Biodiversity Framework (IPBES, 2022).

2. Academia as a movement for change

Academia still hinders equal recognition and accessibility to science in the (sub)tropics. From requirements that thwart publishing scientific findings for non-native English speakers or those with limited funding, to not paying cognizance to the identities of scientists and histories of marginalisation at the hiring, funding, and evaluation stages, academia is designed to not be inclusive. One way that (sub)tropical researchers are excluded in this context is through language barriers: although they are from countries that correspond to the majority of the global population with a wide range of languages and cultures, scientific knowledge continues to be communicated largely in only one language, following one general format, and valuing only a small part of human knowledge. Usually, scientists who are non-native English speakers still face challenges in publishing, communicating, and reviewing academic work due to their origin country or mother language (Amano et al., 2023; Fox et al., 2023; Maas et al., 2021; Smith et al., 2023). Actions such as free language editing services for non-native English speakers and incentives for multilingual text would help to promote multilingual scientists (as many in the (sub)tropics are) both in the global and local communities. Organizations such as SciELO, Public Knowledge Project and EcoEvoRxiv support the publication of scientific products in multiple languages (Public Knowledge Project, n.d.; SciELO, n.d.; SORTEE, n.d.). Finally, it is imperative that people in power (be them journal editors or department heads) take immediate action to punish unethical comments related to ethnicity, language, and gender of academics.

Publishing, both in numbers and impact, is currently crucial for advancing scientific careers, with open access being a bonus. However, open publishing is often costly (in particular

products under a Gold Open Access agreement) and thus a limited opportunity for researchers from the (sub)tropics (Kowaltowski et al., 2021; Smith et al., 2022). Ideally, open access publishing fees should be set at much lower rates globally, if rated at all. Alternatively, the assessment of accessibility to waivers should be multifaceted and not focused only on a single aspect (e.g., global economic indexes). Instead, on local investment in research and development and on political dynamics (*e.g.*, considering political, economic or environmental threats) (Kowaltowski et al., 2021). According to Taubert *et al.* (2021), these waivers when granted to developing countries are not going to cause much revenue loss to the publishers and therefore can be economically feasible. A possible approach, therefore, is for academic institutions, journals and societies to incentivize mentorship and inclusion of local counterparts in publishing, through mandates (*e.g.* by requiring funded research to be published openly) **and** rewards (*e.g.* highlighting or waiving processing fees for articles with local authors), synergistically working with funding policy mandates (mentioned above) to increase representation.

While academic prestige is still dependent on the number of publications and citations, new generations of scientists are challenging the old system, moving from high-impact publishing goals to high social impact endeavours. Beyond the h-index, early career researchers are calling for new frameworks for assessment that recognize and reward outputs that contribute to diversity, equity and inclusion and other "service" efforts (Esposito et al., 2022; Goring et al., 2014). In this context, Open Science culture has been a welcoming environment for change led by ECRs. They are often the ones engaging in open access initiatives, developing open source software and sharing their data. In Latin America, Argentina pioneered the mandates encouraging the open publication of research outputs, but still, there's a lack of infrastructure to support this behaviour (Arza and Fressoli, 2019).

It urges, then, that academic institutions and scientific societies expand existing merit and reward systems to recognise contributions that build knowledge collectively (*e.g.* by co-leading authorship as in Dryflor *et al*. (2016)) and ensure that scientists are creating ethical outputs (*e.g.* Cooke et al., 2021). Moreover, it is key that mandates related to Open Science do not follow a single format, as the concept of Open Science is context dependent (as are the different requirements, actors, even in different stages of research (Chan et al., 2019)) and should not serve to the purpose of imposing a model of science from one country upon another. Similarly, our career path might differ greatly depending on which country we live in (paid internships might not be the norm, access to highly functional computational infrastructure might be impossible, social demands might impose a different pace to our scientific production, etc.), and having that in mind in selection processes and career recognition of all sorts has a great potential to diminish the barriers impeding a global exchange of scientists. By making science better connected, open and equitable, academic institutions will create a mechanism that welcomes everyone to the big table, and these systemic changes within academia will enhance the collaboration and perceived benefits of science, and ultimately feed into national and global policies.

3. Change-makers are people within academia

The breaking down of barriers faced by ECRs in (sub)tropical countries can also come from creating and fostering connections at a more personal level. ECR's from the (sub)tropics might perceive themselves as not being part of the larger research community, and thus it might be hard for us to speak out or engage with others about our research, something which is further exacerbated by the high costs associated with attending larger conferences. While travel support and fee waivers are available, these are often limited and highly competitive, requiring additional

time and effort, especially from ECRs (Valenzuela-Toro and Viglino, 2021). Such conferences and meetings are key in that they may be the only "big" platforms for ECRs based in (sub)tropical regions to be visible outside of their networks. The global scientific community could contribute to bridging this gap by interacting and engaging with research groups from (sub)tropical regions regularly while including them in the global conversation both through "low-cost" measures (*e.g.*, inviting ECRs to give virtual guest presentations during lab meetings) to more "high cost" initiatives (*e.g.* hiring ECRs as guest researchers), as well as being critical of authorship team composition when reviewing papers and grants. These ally attitudes can help to foster long-lasting, collaborative, relationships that would transcend larger geographic barriers, something that is particularly meaningful for ECRs (Pannell et al., 2019). With these suggestions, we strongly emphasise that non-(sub)tropical scientists play a significant role in the change we envision for (sub)tropical science by helping centre scientists from (sub)tropics in global discussions.

Science communication is key to nurturing scientific support, informing and gardening a sense of stewardship to the public. The need for stakeholder engagement and meaningful exchange with local knowledge systems is a global topic of conversation (Sterling et al., 2017), but it is perhaps of greater importance when doing research outside of one's immediate country/area of expertise (*e.g.* Sacande & Berrahmouni (2016) showcase the value in cross-border community engagement when developing restoration projects). Taking part in sci-comm activities aimed at (sub)tropical regions might help to highlight the value of research and local scientists to their communities and even encourage the youth to pursue a career in science. Even though science communication efforts demand institutional support, meaningful conversations happen one-on-one and therefore are ultimately the result of a personal drive.

Manifesting the future

It is often normalised that a successful scientific career cannot be pursued in our home countries. Being far from home ourselves, we acknowledge we are privileged to have had the opportunity to work and study abroad, although here we question whether this is a privilege or a contingency (Del Valle, 2023). With this disclaimer, we aim to highlight that our commentary is not without biases, and as much as we try to approach problems and solutions from a neutral and realistic perspective, we are still reflecting on things from the perspective of someone who is not working from a (sub)tropical country at the moment. In fact, all six of us are currently working from three of the ten leading countries in natural-sciences research (Index, 2020), and we came here because our home countries (Argentina, Brazil, Colombia, Ghana, and South Africa) did not offer us the professional stability or opportunities we needed to achieve our full potential.

Our vision for the future embraces diversity and the exchange of ideas and experiences. We wish that ECRs from the future will be included in all scientific conversations and that their contributions will be valued. Young scientists from the future will have support from their local governments to pursue their careers without having to choose between funding and training, and staying close to their friends and families. The bottom line from our imagined future is that **communication is key** - engaging with broader communities, listening to the challenges faced by researchers, and opening cross-border discussions between policy-making bodies. Ultimately effective communication is both a mechanism for participating at a larger scale and improving the transparency of shortcomings from within the system. This commentary piece is not an attempt to delineate ultimate solutions to the practice of science but rather invites the scientific community to look at and be aware of the differences among different countries. We invite you

to build this future with us, so the next generation won't need to go through the same preventable challenges we needed to.

Figure legends

Figure 1 –

[English] Points of entry for change: how we can act now to re-design the future of tropical ecology for early career researchers. Public policies should ease international collaborations (including funding), while cultural changes in academia will value non-English communication. Individual attitudes towards inclusion of (sub)tropical ECRs in a global context would then become the norm.

[Malayalam] മാറ്റത്തിനായുള്ള പ്രവേശന പോയിന്റുകൾ: കരിയറിലെ ആദ്യകാല ഗവേഷകർക്കായി ഉഷ്ണമേഖലാ പരിസ്ഥിതിയുടെ ഭാവി പുനർരൂപകൽപ്പന ചെയ്യാൻ നമുക്ക് ഇപ്പോൾ എങ്ങനെ പ്രവർത്തിക്കാം. പൊതു നയങ്ങൾ അന്താരാഷ്ട്ര സഹകരണം (ഫണ്ടിംഗ് ഉൾപ്പെടെ) ലഘൂകരിക്കണം, അതേസമയം അക്കാദമിയയിലെ സാംസ്കാരിക മാറ്റങ്ങൾ ഇംഗ്ലീഷ് ഇതര ആശയവിനിമയത്തെ വിലമതിക്കുന്നു. ആഗോള പശ്ചാത്തലത്തിൽ (ഉപ) ഉഷ്ണമേഖലാ ആദ്യകാല കരിയർ ഗവേഷകരെ ഉൾപ്പെടുത്തുന്നതിനുള്ള വ്യക്തിഗത മനോഭാവം അപ്പോൾ ഒരു മാനദണ്ഡമായി മാറും.

[Spanish] Puntos de entrada para el cambio: cómo podemos actuar ahora para rediseñar el futuro de la ecología tropical para los investigadores que inician su carrera. Las políticas públicas deberían facilitar las colaboraciones internacionales (incluida la financiación), mientras que los cambios culturales en el mundo académico valorarán la comunicación no inglesa. Las actitudes

individuales hacia la inclusión de los ECR (sub)tropicales en un contexto global se convertirían entonces en la norma.

[Portuguese] Pontos de entrada para mudanças: como podemos agir agora para redesenhar o futuro da ecologia tropical para pesquisadores em início de carreira. As políticas públicas devem facilitar as colaborações internacionais (incluindo financiamento), enquanto as mudanças culturais no meio acadêmico valorizarão a comunicação não-inglesa. Atitudes individuais em relação à inclusão de ECRs (sub)tropicais em um contexto global se tornariam então a norma.

Figures

Figure 1 in English

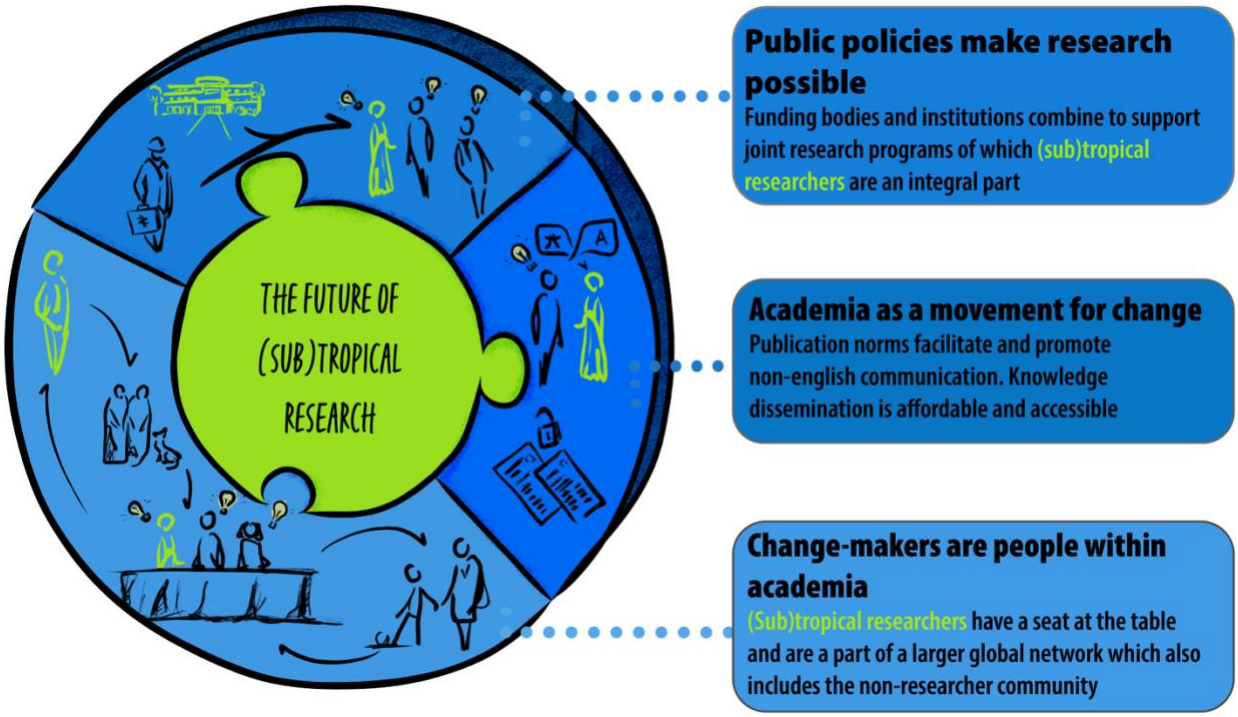


Figure 1 in Malayalam

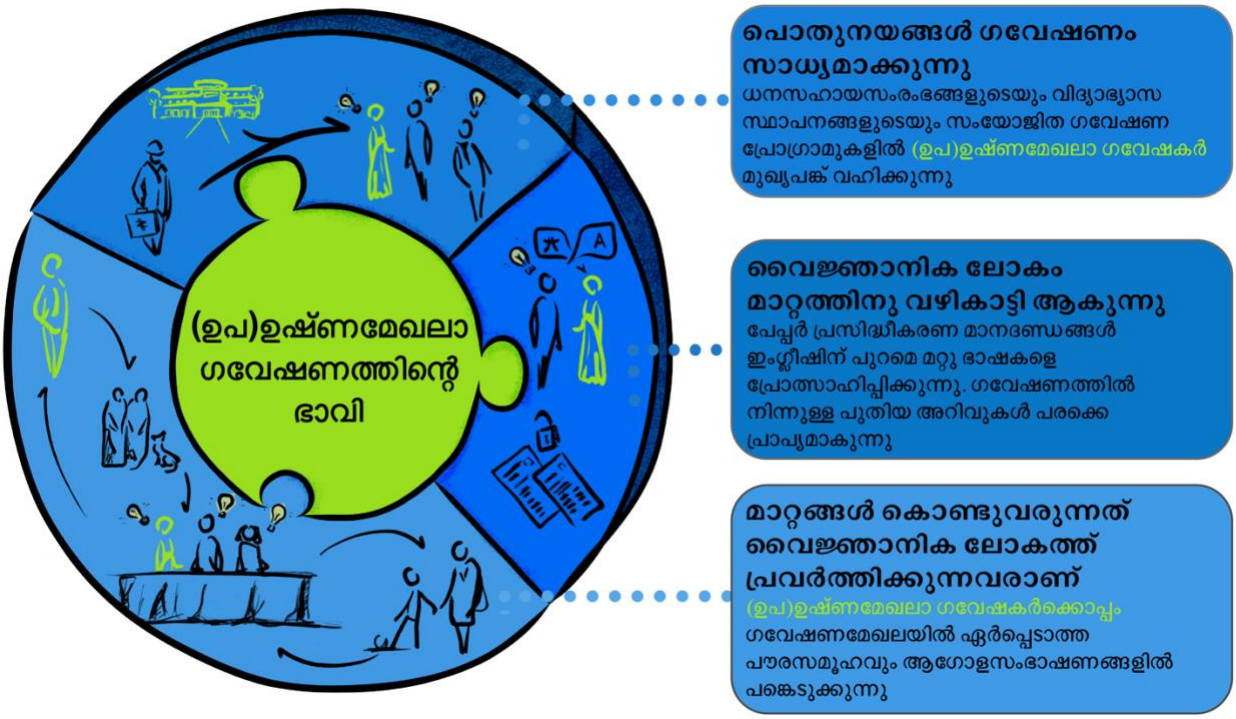


Figure 1 in Spanish

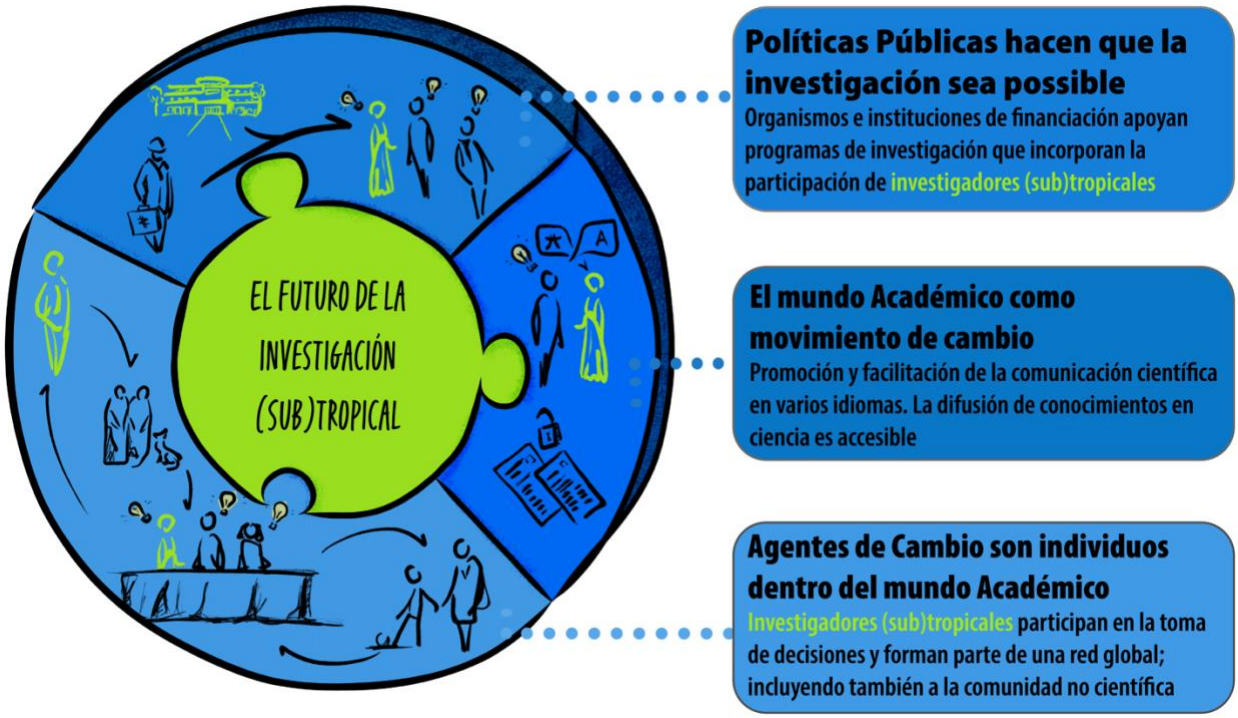
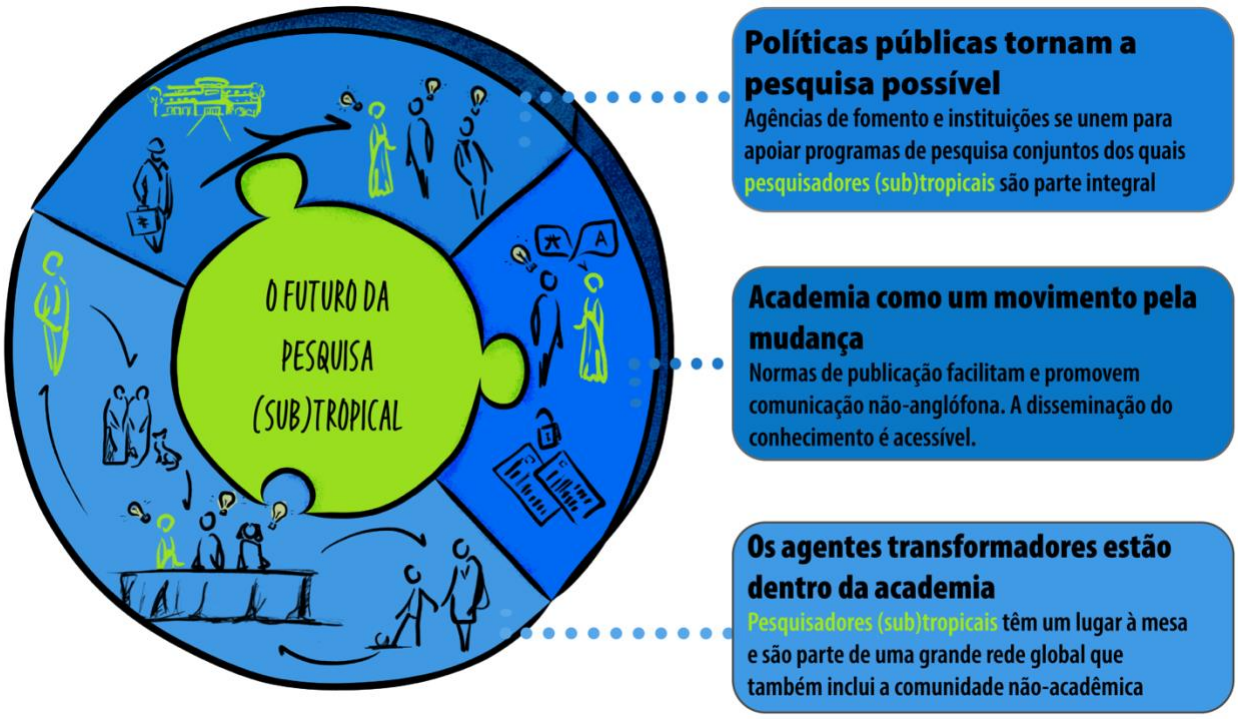


Figure 1 in Portuguese



Box 1 - Story from the future

At the end of the session, we asked participants to write a speculative story about a scientist from the future who lives in a (sub)tropical region, based on what we've had discussed and on what we've explored of other peoples' stories. The following text was adapted (for means of clarity) from the original product (available as supplementary material):

"We are in a conference. Participants are presenting their most recent research using the language they are most comfortable with, and translation services are provided widely. They were encouraged to use multiple languages in their supporting visuals if they wanted to. As we walk through posters, we see a fun mismatch between spoken language and visuals, and posters are now multidimensional - you can smell one, touch another, and build another one. Sign language interpreters are spread out in the room.

Many of these scientists will have their posters turn into scientific papers that will be published in the open. Some of these posters are already preprints, and the discussion around it is actually a peer-review, which will also be published and used in the publication process. By the time these scientists submit their manuscripts to an open-access journal, published by a scientific society, they will not have to pay unreasonable processing fees, and the intellectual property will remain with the research group that produced it.

Back home - and they are back *home* because they are valued there -, they do not suffer any kind of harassment. They find a welcoming and safe place to work because there are systemic mechanisms and policies that are effective against misbehaviour in the community. These scientists feel safe reporting any misconduct of their superiors to their institutions and the

scientific societies to which they are related. Their efforts on science communication in their mother language are encouraged and rewarding, and they are more and more enthusiastic about building science ***with*** - not *to* or *about* - their local communities."

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Author Contribution Statement

These co-authors contributed equally to this work and reserve the right to prioritise their names in the publication list on their CV.

Contributor Roles Taxonomy: Conceptualization, Writing – original draft, Writing – review & editing

Conflict of Interest

The corresponding author confirms on behalf of all authors that there have been no involvements that might raise the question of bias in the work reported or in the conclusions, implications, or opinions stated.

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