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Authors: Báez, Selene, Mazzarino, Meagan, Peralvo, Manuel, and Sears, Robin R.

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MountainDevelopment
Transformation knowledge

Evaluating the Impacts of a Small-Grants Program on Sustainable Development and Biodiversity Conservation in Andean Forest Landscapes

Selene Báez[1]*, Meagan Mazzarino[2], Manuel Peralvo[3], and Robin R. Sears[4,5]

** Corresponding author: selene.baez@epn.edu.ec*

[1] *Departamento de Biología, Escuela Politécnica Nacional del Ecuador, Ladrón de Guevara E11-253 y Andalucía 17-01-2759, Quito, Ecuador*
[2] *Independent researcher, Delmar, NY 12054, USA*
[3] *Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN), Germán Aleman E12-123 17-05-04, Quito, Ecuador*
[4] *Center for International Forestry Research (CIFOR), Situ Gede, Sindang Barang, Bogor 16115, Indonesia*
[5] *Williams College, 880 Main St, Williamstown, MA 01267, USA*

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International sustainable development and conservation agendas can help regional decision makers to frame their own agendas. Agendas can guide programs and initiatives that drive funding and capacity development for research, and the research, in turn, provides knowledge, evidence, capacity building, and impetus for action. Deficits in research capacity, knowledge, and funding confound efforts on the impact pathway from agenda to outcome. Small-grants programs can play an important role in filling these gaps. In this paper, we evaluate a suite of impacts of a small-grants program linked to a regional research agenda for the Andean forest landscape. Using the concept of additionality, and analyzing the database of applications for the solicitation process and responses to a questionnaire by awardees, we evaluated the effects of the funding on research input, outputs and outcomes, and transformative application to sustainable development. We found that the solicitation process, which yielded 180 applications, fell short of its goal of attracting applicants well distributed among the Andean countries, applications from women, and applications for interdisciplinary transformative research projects. Nevertheless, the 15 projects that were funded did ultimately cross disciplinary lines, result in diverse outputs and outcomes, and help to advance work toward achieving sustainable development and biodiversity conservation in the Andean forest landscape. We recommend that small-grants programs that focus narrowly on a topic or region be supported and that they strive to elevate regional researchers and women in the community of practice.

Keywords: *Aichi biodiversity targets; Andes; biodiversity conservation; impact evaluation; research capacity; small research grants; sustainability agendas; sustainable development goals; montane forests.*

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Introduction

The tropical Andes is one of the most biologically diverse and threatened hotspots on earth (Myers et al 2000; Brooks et al 2002; Boillat et al 2017). In this mountain region, Andean forest landscapes (AFLs) are of special interest as centers of endemism, cultural diversity, agriculture, and livestock production (Baker and Little 1976; Stadel 2008). Comprising a mosaic of forest, high-altitude grasslands, and human land uses, AFLs provide a diversity of goods and ecological services to more than 50 million people (Wymann von Dach et al 2018).

Despite the rich biodiversity and natural resource base to sustain rural livelihoods, this tropical montane region presents high levels of poverty and environmental degradation (Hentschel and Waters 2002; Agudelo et al 2003; Farrow et al 2005; Brandt and Townsend 2006; Stadel 2008). Conservation and sustainable development efforts to address these issues require equal consideration of natural and social systems, but often fall short because of deficits in research capacity, knowledge, and funding (Feeley 2015; Báez et al 2016). These deficits hinder the impact pathway from knowledge to decision-making to action and outcome (Messerli et al 2019).

Basic and applied research form the foundation of the impact pathway. For Latin America, there is a positive relationship between government funding and scientific production (Chudnovsky et al 2008; Aboal and Tacsir 2017). However, funding is sorely lacking, particularly for the Andean region and in the areas of conservation and sustainable governance (Pitman et al 2011).

Funding strategies to enhance research that supports sustainable development, biodiversity conservation, and environmental policy are diverse and include competitive offers from global to regional public and private agents, ranging from very large to very small awards. Small funding programs were commonly part of conservation projects during the 1990s and have been shown to be effective

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(Thompson et al 2010; Fortin and Currie 2013), but the current trend in research funding internationally is to fund fewer but larger-scale projects (Bloch et al 2014). For example, a review of the outcomes of grants targeted to biodiversity and conservation in Central and West Africa found that small grants (<US$ 50,000) accounted for only 5% of all project funding (Powell and Mesbah 2016). The small grants, however, had high impact on the ground, as they tended to provide more flexible, innovative, and diverse programming than the large grants. Small research grants can double scholarly productivity (El-Sawi et al 2009) and result in additional benefits, including innovation (Lerchenmueller 2018), research capacity (Horta et al 2018), extended scientific and nonscientific collaborations, and additional funding (Kulage and Larson 2018). These additionalities are rarely measured, although they are critical to evaluate the broader on-the-ground impacts on sustainable development, policy action, and capacity development (IOE-GEF 2018).

In this paper, we present a case study of how a targeted small-grants program linked to a regional research agenda focused on the AFL has helped to fill gaps in various areas related to research capacity and knowledge production. We assess how the funded projects resulted in actions and knowledge needed to support components of regional and international agendas that aligned, guiding efforts on biodiversity conservation and sustainable development. We use the concept of additionality (Bloch et al 2014) to evaluate the impact of the funding strategy by quantifying the effects of the funded projects on the production of different types of scientific knowledge and contributions to sustainable development and biodiversity conservation at local scales.

We discuss a regional research agenda for the AFL (AFL-RA; Mathez-Stiefel et al 2017), its linkages to international agendas, and its role as the conceptual basis for the fellowship program of the Andean Forest Program (Programa Bosques Andinos; PBA by its Spanish acronym). Then we evaluate the small-grants program of the PBA, including aspects of the solicitation process to explore the target population of researchers working in AFLs, and the kinds of investigations proposed. We apply the concept of additionality of the funding to evaluate the broader impacts of the projects, considering outcomes and outputs and different kinds of knowledge and actions, all in the framework of the AFL-RA. Finally, we present lessons learned and recommendations for small research grant programs. Understanding the broader impacts of small research grants is critical to optimize investments intended to promote biodiversity conservation and sustainable development in highly diverse and threatened regions of the planet.

Influential development and research agendas

International agendas such as the 2030 Agenda for Sustainable Development (UN 2015) and the Aichi Biodiversity Targets (CBD 2011) serve to promote broad, interrelated objectives in topical areas of global concern. They provide context to the world's most pressing problems for society and nature and are a call to action by international, national, and regional policymakers, practitioners, and researchers to effect real change. The challenge for these actors is where to focus efforts and how to move from and across agendas and broad goals to implementation (Van Vianen et al 2015; Stafford-Smith et al 2017). This transformation from global goal to local action requires linking across scales and addressing barriers to action (Wymann von Dach et al 2018). These goals, supported by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Global Assessment Report on Biodiversity and Ecosystem Services (Díaz et al 2019), build on the realization that the conservation of the environmental commons is a critical component of global efforts to attain sustainable development (Messerli et al 2019).

Mountain landscapes are particularly complex and benefit from concerted work in agenda setting to guide efforts to address sustainable development and biodiversity conservation goals (Björnsen Gurung 2006; Björnsen Gurung et al 2012; Gleeson et al 2016). Regional research agendas play a critical role in linking international agendas to priority areas of national and local concern. They guide initiatives that drive funding and capacity development for research, and the research, in turn, provides the knowledge, evidence, capacity building, and impetus for local action (Bloomfield et al 2018).

The UN Sustainable Development Goals (SDGs) find expression for a tropical montane region in the AFL-RA (Mathez-Stiefel et al 2017). This treats the AFL as a socioecological system, considering all aspects of the coupled human and natural system. Research priorities are presented according to the type of knowledge needed to support sustainable development. Systems knowledge describes how human and natural systems work; target knowledge defines a common vision of development and science; and transformation knowledge informs our understanding of how to shape the transition from the current to the envisioned situation (Mathez-Stiefel et al 2017).

The AFL-RA and international agendas address social and natural components of earth systems in a balanced way. The questions for regional actors are how to operationalize these agendas at the regional scale and how to provide a link across multiple dimensions, such as conservation and development, and the natural and social components of systems. An additional question lies in how to get from a datum generated through research to change on the ground. This requires efforts along a chain, from building capacity, to generating knowledge, to communicating science, to agents of change. The role of regional institutions is critical for creating pathways for change.

Evaluation of the Andean Forests Fellowship Program

The PBA small-grants program

The PBA is an initiative that has been funded by the Swiss Agency for Development and Cooperation since 2015. The overall goal of the PBA is to reduce the vulnerability of people and ecosystems to climate change by promoting mitigation, adaptation, and sustainable development in AFLs. The PBA launched a small-grants program in 2016 to address the funding gap and to specifically link to the AFL-RA. The funding program comprised a key component of the PBA's theory of change, or impact pathway (Oberlack et

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al 2019), because it provided a mechanism to support the production of scientific knowledge to inform policies and actions supporting sustainable development, with an intended goal to support the development of research capacity in Andean countries. The program chose to offer numerous small awards instead of few large grants to allow for the exploration of a broader set of topics and geographic locations in the Andean region. The awards were primarily, though not exclusively, for research rather than for implementation or innovation.

The PBA fellowship program welcomed proposals from a diversity of disciplines, conceptual frameworks, methodological approaches, and project activities beyond research. The program targeted established researchers and practitioners to conduct synthesis studies and graduate students for basic research, each receiving different levels of funding (US$ 12,000 and US$ 4000, respectively). Two rounds of funding, in 2016 and 2017, were announced on the PBA website and disseminated broadly via email to relevant professional networks.

Applicants categorized their project in 1 or more of 4 thematic areas: biodiversity and ecology, forest restoration, sustainable management of forest landscapes, and environmental policy. The first call for proposals required applicants to identify only 1 theme, whereas the second required that proposals be interdisciplinary. Proposals in both rounds that applied to more than one area were prioritized. The award selection process, set by the program board, evaluated scientific relevance, interdisciplinary approaches, geographic scope, and international collaboration. Proposals presented by female researchers based in Andean countries received additional points. Two external peer reviewers evaluated each proposal, and the fellowship board members oversaw the results.

Evaluation method

Our evaluation of the PBA fellowship program was framed by a theory of change to assess the kinds of knowledge produced and promoted by the funding and by the effect of the funding. For the latter, we used the concept of additionality (Bloch et al 2014), which identifies the effects of the funding on different variables. We evaluated outcomes related to 2 aspects of the small-grants program: the solicitation process and the funded projects. On the first issue, the evaluation was guided by questions of whether the solicitation process generated interest from the target populations: graduate students and early-career scientists from the Andean region and women. We used descriptive measures to evaluate the variables of origin, identity, and career stage of applicants and the nature of the research questions and methods. The information was gleaned from the application database.

An online questionnaire (*Supplemental material*, Appendix S1: https://doi.org/10.1659/MRD-JOURNAL-D-19-00066.1.S1) was sent to the 15 fellowship recipients (once they had all completed their projects), and elicited a response rate of 87% (13 grantees). We asked about aspects of the development and completion of the projects and their contribution to conservation and SDGs. We presented options in 3 types of outputs and outcomes: (1) generation of knowledge, (2) public engagement and awareness raising, and (3) kinds of actors engaged (Table 1). From their responses, we framed the analysis based on types of additionality. The first 2 effects we borrowed from Bloch et al (2014): *input additionality*, or the effects of funding on the research itself, that is, whether the grant facilitated research activities that otherwise might not have been undertaken; and *output additionality*, or the effects of the funding on scientific production, research capacity, and skills development. Because we were interested in how the funding might have facilitated actual change on the ground, we proposed a third type of effect of the funding program,

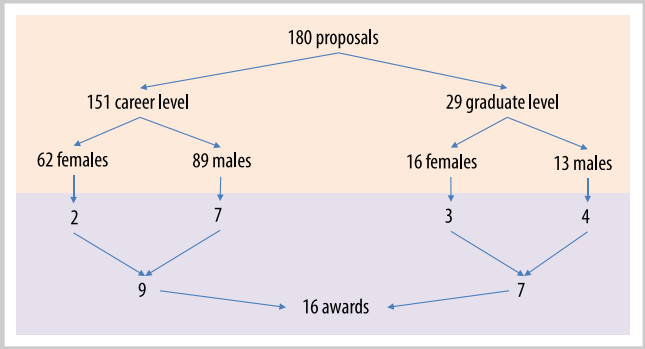
TABLE 1 Outputs and outcomes that resulted from 13 studies funded by the small-grants program of the Andean Forest Program.

Outputs and outcomes	Number reported	Average per project
Outputs: generation of knowledge		
Publication, peer-reviewed[a)]	9	0.7
Publication, popular	5	0.4
Presentation[a)]	12	0.9
Academic thesis[a)]	15	1.2
Workshop/training[a)]	6	0.5
Management plan	2	0.2
Policy/regulation	1	0.1
Total	50	3.8
Outcomes: public engagement and awareness raising		
Increasing scientific knowledge	13	1.0
Mentoring and training	7	0.5
Partnerships	6	0.5
Policy discussion, analysis	5	0.4
Action plan	2	0.2
Outreach	3	0.2
Total	36	2.8
Kinds of actors engaged		
Individuals in community	8	0.6
Community groups	6	0.5
Indigenous groups	3	0.2
Education groups or children	4	0.3
Nongovernmental organizations	3	0.2
Government entity/official		
Local	6	0.5
Regional	5	0.4
National	2	0.2
Other (media)	2	0.2
Total	39	3.0

[a)] Indicates scholarly products.

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FIGURE 1 Proposals reviewed and awards granted by the small-grants program of the Andean Forest Program indicating applicants' career status and gender.



application additionality. This we defined as the effect of the funding on advances toward broader goals. In this case, we focused our assessment on how the projects addressed the overall mission of the PBA program and specific related targets of the AFL, SDGs, and Aichi agendas. These effects were assessed by evaluating grantee responses to the questionnaire and follow-up interviews.

Solicitation and award outcomes

Over the 2 solicitation cycles, the program evaluated 180 proposals: 151 for synthesis studies by career scientists and practitioners and 29 for graduate research (Figure 1). The application rate for synthesis projects was lower for females than for males, and slightly higher for graduate research. The funding rate was also lower for females than for males, with 5 and 11 funded projects for females and males, respectively (female-to-male ratio of 1:2.2). Seven grants were awarded to graduate students (4 masters, 3 doctoral), and 9 for synthesis studies by career researchers (*Supplemental material*, Table S1: https://doi.org/10.1659/MRD-JOURNAL-D-19-00066.1.S1). In the end, the fellowship program awarded US$ 136,000 to 15 one-year grants over 2 calls (1 awardee declined).

The proposals were from applicants based in 11 countries (*Supplemental material*, Figure S1: https://doi.org/10.1659/MRD-JOURNAL-D-19-00066.1.S1), with almost two thirds originating from Colombia, Ecuador, and Peru.

FIGURE 2 Country of origin of the lead researcher and geographic focus of research for awarded grants of the small-grants program of the Andean Forest Program.

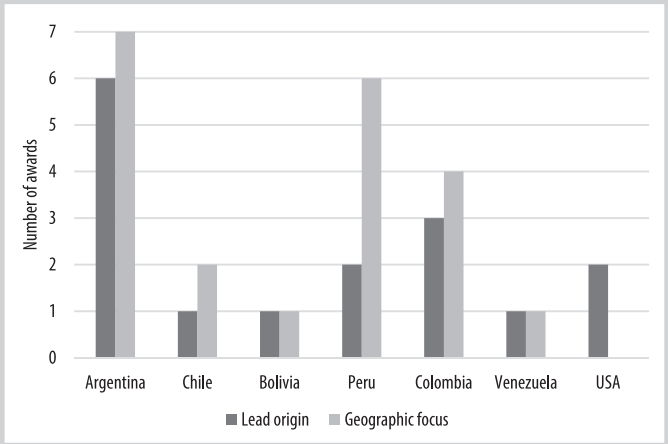
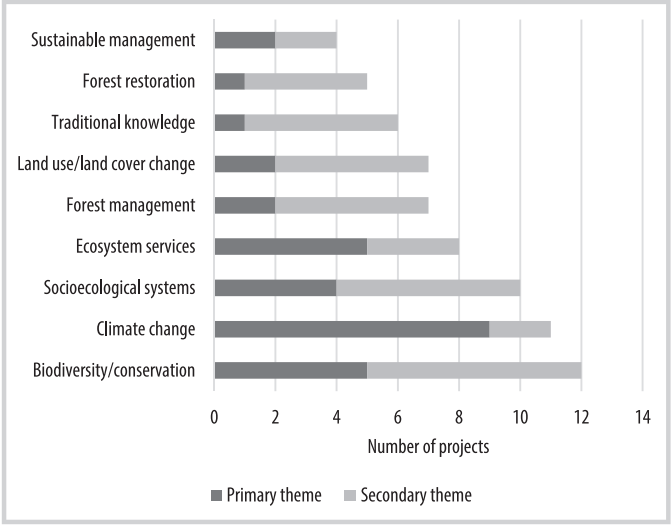


FIGURE 3 Primary and secondary themes of research addressed by the awarded projects.



Thematically, the proposals were overwhelmingly biased toward the natural sciences, with only 20% having a primary focus on a social theme or taking an interdisciplinary approach (*Supplemental material*, Figure S2: https://doi.org/10.1659/MRD-JOURNAL-D-19-00066.1.S1).

The largest number of grants was awarded to leads from Argentina (6), followed by Colombia (3), Peru (2), and the United States (2) (Figure 2). Likewise, the southern Andes received the most attention in the studies, with 43% of the projects conducting research in Argentina and/or Chile. Four of the 15 studies were carried out in 2 Andean countries: 1 each in Argentina/Peru and Colombia/Peru, and 2 in Argentina/Chile.

Recipients ranged across 6 career levels, from master's degree students to practitioners, with women represented mostly at the earliest levels (graduate students, early career) (*Supplemental material*, Figure S3: https://doi.org/10.1659/MRD-JOURNAL-D-19-00066.1.S1). Ten of the 13 projects (responding to the questionnaire) were led by a team, and 3 were led by a single investigator. Collectively, the 13 projects engaged approximately 100 people on their research teams, 30% of whom were women.

Project outputs and outcomes: contributing to the program goals and agendas

As with the proposals, thematically, the projects focused mostly on natural sciences and had the goal of generating systems knowledge. Interdisciplinarity was indicated post hoc by the project leads, as more than half identified forest restoration and sustainable management as primary foci in addition to biodiversity and ecology, with almost half indicating a secondary or tertiary theme of environmental policy (Figure 3). Only 1 identified transformation, and 2 indicated that their project generated both systems and transformation knowledge. None indicated a contribution to target knowledge.

The funded projects resulted in a diversity of outputs and outcomes. As we expected, because of the focus of the projects on systems knowledge, projects generated mainly outputs related to generation of knowledge, with an average of 3.8 outputs per project (Table 1) communicated through

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scholarly works. Fifteen academic theses were produced by project team members, including 9 by undergraduate students in Andean countries and 3 each for master's and doctoral degrees. This corresponds to an average of 2.8 scholarly products (academic theses, peer-reviewed publications, presentations, and workshops/trainings) per project (Table 1). Thus, the projects strongly supported development of regional research capacity in several ways.

In terms of input additionality, we do not have direct evidence that the research conducted would not otherwise have been undertaken without the grant support from PBA. That said, we do believe that because of the nature of the calls and the small size of the grants, these projects would not have been conducted in the particular manner in which they were approached, with a focus on interdisciplinary research, participatory methods, and outcomes-driven goals. Indeed, all of the fellowship recipients felt that their research contributed in some way to increase public awareness of the need for Andean forest biodiversity conservation through outputs and events oriented toward local people. We consider these to contribute to the application additionality of the funding.

Outcomes related to public engagement and awareness raising were also strong (averaging 2.8 per project; Table 1). Indeed, the projects engaged with different types of actors who were potentially involved with sustainable development, biodiversity conservation, or environmental policy (eg local and national government entities, officials, local field assistants; Table 1). Other examples of public engagement or local relevance included community workshops to share study results and solicit feedback, conduct demonstration activities, or train local people. For example, 2 projects produced a booklet or guide for local people. One project conducted a presentation at a local school and produced written material on lianas and epiphytes for local guides. A project about forest growth rate, determined by tree ring analysis, informed a community on the age of their forests and other information to apply in their ecotourism initiatives.

A priori consideration of the AFL-RA, the SDGs, or the Aichi targets by grant recipients was low. Only 7 project teams reported that they had considered the AFL-RA in the design of their project, and none reported considering either Aichi or SDG targets. Post hoc consideration was higher when project leads were presented with a subset of items and targets for each of the agendas, which allowed us to assess application additionality of the funding.

From the AFL-RA, 20 out of 34 items presented to teams were indicated by respondents as relevant to their work. The most commonly cited priorities fell under generating systems knowledge associated with the AFL theme of understanding and measuring impacts of global socioenvironmental change (Table 2). The top selected item under target knowledge was 4.1, on the perceptions, values, and identities of actor categories. Only 5 of the 14 items listed under transformation knowledge in the AFL-RA were cited by researchers, which may reflect a gap between research and action, and even the consideration by researchers of the broader relevance and application of their research.

The researchers related their projects to international agendas mainly in the areas of biodiversity and sustainable development. Of the 17 SDGs and 169 targets, 9 goals and 28 targets were presented to the researchers. Fourteen of these targets were selected by the research groups, with SDG 15, on Life on Land, receiving the most focus. Target 15.4, on conservation in mountain ecosystems, was most cited, by 6 of the projects, followed by 4 mentions each of 15.2, on sustainable forest management, and 13.2, on relating climate change measures to policy (Table 2). Although they were presented to researchers in the subset, targets on hunger (SDG 2), gender equality (SDG 5), and work and economic growth (SDG 8) were not selected. Similarly, the top Aichi targets indicated by respondents were targets 1 and 19, related to awareness raising on the values and conservation of biodiversity, and knowledge, science, and technology, respectively (Table 2).

Lessons learned

This case study demonstrates that a small funding program can help produce scientific knowledge, enhance research capacity, and advance regional and international goals on biodiversity conservation and sustainable development. Our assessment suggests that the PBA program has contributed significantly to the generation of systems knowledge about the AFL, but has contributed less to target and transformation knowledge, as defined in the AFL-RA. While the projects funded by the program were primarily focused on natural systems of the landscape, and on early-career scientists and graduate students, who tend to focus on early results, all had some application, either directly or indirectly, to understanding and addressing elements of the social components. While we acknowledge the critical need for systems knowledge, future funding programs should explicitly encourage even basic researchers to include activities in their work that apply the knowledge they generate, thus providing target and transformation knowledge. At the very least, future programs should encourage them (perhaps through supplementary funds) to translate their research results to a format that will serve decision makers at all levels of governance.

Links between knowledge production and action are not always directly apparent in research, but our assessment of the application additionality of this funding program suggests that these small research projects did contribute to advancing regional and global agendas for biodiversity conservation and sustainable development. Even researchers focusing on ecological and biodiversity topics in a stricter sense engaged in activities that enhanced local research capacity, knowledge, and local training.

While the program helped to meet some of the funding needs of researchers and practitioners in Andean countries, efforts to support female and male researchers equally fell short. This imbalance may stem from a general gender disparity in sciences, technology, engineering, and mathematics fields in Andean countries (with the exception of Argentina, Bolivia, and Venezuela) (UIS 2018). The gender disparity among project leads may also have contributed to low representation of women involved in the research projects overall, as cultural barriers still make it difficult for women to hold positions of authority beside men in Latin America (eg Franco-Orozco and Franco-Orozco 2018). Thus, we strongly suggest that small-research-grant programs place a stronger emphasis on promoting gender equality to help

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TABLE 2 The key targets from the Andean Forests Landscapes (AFL) Research Agenda (Mathez-Stiefel et al 2017), the Sustainable Development Goals (SDGs) (UN 2015), and the Aichi biodiversity targets (CBD 2011), and the number of times they are referred to by the surveyed fellowship recipients ($n = 13$).

Targets		Number of respondents
AFL	**Description**	
1.1	Understand patterns of tree diversity, forest structure and dynamics, and carbon stocks	7
1.3	Understand effects of abiotic factors on responses of forest ecosystems to global change	7
1.6	Characterize the contribution of structure and functioning of forests to ecosystem services	7
4.1	Elucidate the perceptions, cultural values, identities, and knowledge of different actor categories	7
Aichi		
1	By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably	7
19	Aichi strategic goal E: Enhance implementation through participatory planning, knowledge management, and capacity building By 2020, knowledge, the science base, and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied	6
SDG		
6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes	5
15.2	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation globally	4
15.4	By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	6
13.2	Integrate climate change measures into national policies, strategies, and planning	4

bridge the gender gap in Andean countries (López-Aguirre 2019).

Our findings support the idea that small-grant programs contribute to building local research capacity and enhancing researchers' future career prospects and collaboration networks inside and outside academia, thus promoting stronger research communities (El-Sawi et al 2009; Horta et al 2018; Kulage and Larson 2018). Indeed, the PBA small-grants program has generated a community of researchers and practitioners who can contribute to the iterative process of defining and working toward achieving regional conservation and development goals.

Conclusions

It is worthwhile for program directors and researchers alike to contemplate the design of funding programs and research projects that result in diverse outcomes, including building and strengthening pathways and processes that lead to real changes in awareness and behavior vis-à-vis conservation and development. The use of the theory of change as a tool at 3 levels (agenda setting, funding programs, and project development) can help to guide this process toward effective planning. We recommend that grant program evaluations target the application additionality of the funding, that is, follow up to evaluate real advances in the theory of change framework. The theory of change can also help to focus the call for proposals on specific problems or areas of research, which would allow the program itself to integrate project outputs and outcomes of the funded projects into its own work and to help make the jump from data to action.

Small-grants programs for research clearly play an important role in building research capacity and generating research outputs. We believe that connecting such programs to regional research agendas can even further optimize the effectiveness of the grant program and improve outcomes on the ground. A strong recommendation by the grant recipients and these authors is to keep small funding programs alive, providing opportunities that engage recipients to maintain momentum and strengthen links within a community of practice. We recommend that such programs commit to elevating regional researchers and women in the community of practice.

We recognize that the role that small-grants programs play in filling a funding gap is just one component of the process for creating change, but it is a critical component. We hope that the lessons presented here provide insights into how such programs can increase their efficacy in supporting the generation of both system and transformation knowledge, and in doing so advance targeted agendas on conservation and sustainable development.

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Supplemental material

APPENDIX S1 Questionnaire for grantees of the small-grants program of the Andean Forest Program.
TABLE S1 Projects funded by the small-grants program of the Andean Forest Program, and their geographic scope.
FIGURE S1 Country of origin and career status of the lead applicant for the reviewed proposals.
FIGURE S2 Percentage of the reviewed proposals by main thematic category as defined by the Andean Forest Program's fellowship program.
FIGURE S3 For awarded projects, career level by gender.

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