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Source: Mountain Research and Development, 36(4):417-430.
Published By: International Mountain Society
URL: http://www.bioone.org/doi/full/10.1659/MRD-JOURNAL-D-16-00051.1

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

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Identifying Gender-Sensitive Agroforestry Options: Methodological Considerations From the Field

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Agroforestry is seen as a promising set of land use practices that can lead to increased ecological integrity and sustainable benefits in mountain areas. Agroforestry practices can also enhance smallholder farmers' resilience in the face of social and ecological change. There is a need for critical examination of existing practices to ensure that agroforestry recommendations for smallholder farmers are socially inclusive and grounded in local experience, knowledge, and perceptions. In this paper, we present a transdisciplinary systems approach to the identification and analysis of suitable agroforestry options, which takes into account gendered perceptions of the benefits and values of natural resources. The 4-step approach consists of an appraisal of local perceptions of the social-ecological context and dynamics, an inventory of existing agroforestry practices and species, a gendered valuation of agroforestry practices and species, and the development of locally adapted and gender-sensitive agroforestry options. In a study using this approach in the Peruvian Andes, data were collected through a combination of participatory tools for gender research and ethnobotanical methods. This paper shares lessons learned and offers recommendations for researchers and practitioners in the field of sustainable mountain development. We discuss methodological considerations in the identification of locally adapted agroforestry options, the understanding of local social-ecological systems, the facilitation of social learning processes, engagement in gender research, and the establishment of ethical research collaborations. The methodology presented here is especially recommended for the exploratory phase of any natural resource management initiative in mountain areas with high environmental and sociocultural variability.

Keywords: *Agroforestry; gender; transdisciplinary research; systems approach; social learning; participatory tools; Andes.*

Peer-reviewed: *May 2016* ***Accepted:*** *August 2016*

Introduction

Agroforestry, broadly defined as the use of trees and shrubs in agricultural landscapes, has a long history in mountain regions dating back to ancient societies (Chepstow-Lusty and Winfield 2000; Reyes et al 2005; Sharma et al 2007; Herrera Wassilowsky 2011). Agroforestry is seen as a promising set of integrated land use practices that can lead to increased ecological integrity and sustainable benefits for smallholders (Sinclair 1999), while also enhancing their resilience in the face of social and ecological change. Trees play an important multifunctional role in mountain dwellers' livelihoods—they provide access to timber, firewood, fruits, and medicinal plants and hold significant cultural values (Reynel and Felipe-Morales 1987; Brandt et al 2012; He et al 2015).

As in other places where agroforestry has developed as an important land use, smallholder farmers in mountain regions have integrated a high number of tree species in various productive niches (Sinclair 1999). This has resulted in a wide diversity of practices, ranging from household- and community-led tree management within traditional farming systems to plantations of exotic species promoted by rural development extension services. In view of promoting agroforestry, there is a need for critical examination of these diverse practices in the context of smallholders' adaptation to global change. In particular, there is a need to ensure that recommendations are solidly grounded in local

experience, knowledge, and perceptions regarding the benefits of different agroforestry options (Walker et al 1995; Reed 2007).

In their proposal for a new paradigm of "research in development" for the scaling up of agroforestry, Coe et al (2014) highlight the need to develop options that take into account the fine-scale variation in social, economic, and ecological contexts. Furthermore, they stress the importance of colearning through horizontal and vertical integration among researchers, development practitioners, and the private sector. An integrated agro-ecosystems and livelihood systems approach such as the one presented by Van Ginkel et al (2013) can be used for this fine-scale understanding of local contexts and the design of appropriate agroforestry options. In dryland agricultural research, these authors marked a turning point by combining explicit systems analysis with participatory approaches. Several colearning tools for natural resource management have been applied since the end of the 1990s. The well-tested Learning for Sustainability approach (CDE 1998; Rist et al 2006, 2009; Schwilch et al 2009) is a prominent example. Researchers implementing this approach have developed tools that enable the inclusion of diverse local and external stakeholders in processes of knowledge coproduction and innovation for sustainable development.

Gender is another key dimension that needs to be considered when selecting agroforestry options in mountain contexts. As recognized in the United Nations' newly adopted Sustainable Development Goals, the participation of women as agents of change and gender equality in policy development are now considered to be crucial for sustainable development (United Nations 2015: Goal 5). In mountain areas, Verma (2014) has called for the advancement of knowledge through rigorous gender research and analysis and for the promotion of policy- and action-oriented research as important domains of gender-transformative change. More specifically, according to Wymann von Dach (2002), research for sustainable development in mountain areas should focus on women's and men's roles and responsibilities, including their access to and control over resources, education and knowledge, and involvement in decision-making. In the Andes, Paulson (2003) has highlighted the specific role that women play in farming systems and how the differences between men and women are reflected in broader asymmetrical relations. While men are usually in charge of land management and the collection of wood for construction and tools, women are responsible for seed conservation, livestock grazing, and fuelwood collection (Paulson 2003; Brandt et al 2013). Men and women also possess different knowledge on and ways of valuing forests and tree species (Salas Laines 2011; Brandt et al 2013).

General frameworks for analyzing gender roles in forest management have been developed in recent years (Colfer and Minarchek 2013), as have specific tools for assessing gender perspectives in agricultural and agroforestry systems (Catacutan et al 2014; Jost et al 2014). However, methodologies that link an integrated farming and livelihood systems approach with the analysis of gendered differences in natural resource management are still scarce. For instance, the toolbox developed by Jost et al (2014) offers concepts and participatory tools that can be used individually according to users' needs, rather than a comprehensive research approach. There is also a lack of concrete recommendations for the application of such tools on the ground to produce, in collaboration with local actors, the knowledge needed to orient development interventions.

In this paper, we present an integrated step-by-step approach for the identification and analysis of suitable agroforestry options, which takes into account gendered perceptions of the benefits and values of natural resources. Drawing on experiences from a research project in the Peruvian Andes, we share lessons learned, offer recommendations for researchers and practitioners in the field of sustainable mountain development, and discuss methodological considerations in the identification of locally adapted agroforestry options, the understanding of local social-ecological systems, the facilitation of social learning processes, engagement in gender research, and the establishment of ethical research collaborations.

Transdisciplinary and iterative methodological design

The methodology described in this paper was developed and applied in the framework of an agroforestry research project carried out in partnership with a development cooperation initiative. The research results have informed the development program's efforts to improve capacities for climate-change adaptation and mitigation in the Andean regions through the scaling up of successful practices, tools, and policies for the sustainable management of forested landscapes.

The research project involved 3 neighboring communities in a microwatershed of the District of Pacobamba in the valley of the Apurímac River in the southern Peruvian Andes (13°33′40″S and 73°06′58″W). These *comunidades campesinas* (peasant communities) were created at the beginning of the 1980s during the Peruvian Agrarian Reform, when the land from haciendas was handed over to local indigenous farmers. The local population, mostly Quechua-speaking and of Chanka and Inca origins, is now involved in subsistence agriculture, cattle raising, and off-farm activities in the neighboring city of Abancay. The research site ranges in elevation from 2000 to 3800 m above sea level (masl) and spans a diversity of ecological life zones, land use and livelihood systems, and farming practices. After a preliminary site visit when

TABLE 1 Four-step research approach.

Step	Theme	Research tools and methods	Research products
1	Appraisal of social-ecological context and dynamics	Community workshops Walks and observations Open-ended interviews	Social-ecological dynamics: community resource maps, climate change timelines Actor analysis: wealth ranking, seasonal calendars, gender roles Community history narratives
2	Inventory of agroforestry practices and species	Community workshops Existing maps and satellite images Semistructured interviews Collection of botanical specimens	Livelihood and land use diagrams Inventory of agroforestry practices and species Botanical specimens of agroforestry species
3	Gendered valuation of agroforestry practices and species	Community workshops Existing maps and satellite images Collection of botanical specimens	Ranking and perceptions of the benefits of agroforestry practices and species List of identified agroforestry species
4	Development of agroforestry options	Community workshops	Products from steps 1–3 validated by local participants Action plans for the promotion of agroforestry practices

authorization to carry out the study was granted by local authorities and farmers, the communities of Ccerabamba (3057 masl), Andina (2759 masl), and Pacchani (2537 masl) were selected to participate in the research, to respectively represent the upper, middle, and lower parts of the microwatershed.

We adopted a transdisciplinary research approach, as deemed appropriate for sustainability-oriented research that aims to respond to society's knowledge needs (Hirsch Hadorn et al 2006). Transdisciplinarity can be defined as a new type of research that transcends both disciplinary and interdisciplinary boundaries by integrating diverse stakeholders in the process of knowledge production (Lang et al 2012). Adopting this approach meant that besides the use of methods from different disciplines, we also sought to actively involve local community members in all steps of the research process. We collected and analyzed the data between February and December 2015. We followed an iterative process that involved a combination of participatory tools for gender research and ethnographical and botanical methods. At the end of each data collection step, we performed an initial analysis of the data and elaborated intermediary research products, which were fed into the design of the subsequent step. We then validated the preliminary results and products with the local participants prior to commencing the next cycle of data collection, data analysis, return of results, and methodological design. The methodological steps and their corresponding tools and research products are presented in Table 1 and detailed in the next section.

We led the research process as a team of facilitators comprised of 3 external female researchers and 2 young male farmers from the study site. The farmers were involved as interpreters and facilitators in the entire research process, from the design of the tools and workshop exercises up to the coauthorship of this paper. As a team, we also held regular debriefing sessions on the process of data collection and analysis, in order to critically evaluate and continually adapt our approach. The methodological considerations presented in this paper are a result of these joint reflections among external researchers and local facilitators.

A total of 156 local community members participated in the study: 97 men and 59 women with ages ranging from 14 to 90 years. In each of the 3 communities, we held 5 workshops and complemented these workshops with in-depth interviews, walks along the communities' territory guided by local farmers, and the collection of botanical specimens of local agroforestry species. In coordination with local authorities, all community members were invited to attend the workshops, with special mention of the importance of the participation of women. While some community members participated in all 5 workshops, others attended only 1 or 2. Participation in each meeting ranged from 10 to 40 people. We carried out all workshops and interviews in Spanish and Quechua, with the help of the local interpreters. We used practical exercises and visual supports such as diagrams and photographs (see Figure 1) to facilitate the participation of all attendants, in particular women and community elders, whose writing skills and knowledge of Spanish are often limited. We usually recorded workshops and interviews and subsequently transcribed them into Spanish. When recording was not possible, we took detailed notes of the discussions. Except for the last workshops on the development of agroforestry options (Step 4 in Table 1), which were purposely conducted in mixed-sex groups, we always split workshop participants into groups of between 5 and 15 men or women. Except

FIGURE 1 Participatory exercises using visual supports and props, such as this pebble game in Pacchani, help document women's knowledge and preferences. (Photo by Sarah-Lan Mathez-Stiefel)

for Step 4, we disaggregated all data by sex and analyzed them with a focus on differences between men and women.

Integrated systems approach to data collection and analysis

The study involved an investigation of agroforestry practices and species in the framework of local livelihood and land use systems. In each of the 3 communities, our 4-step research approach consisted of (1) an appraisal of the social-ecological context and dynamics, (2) an inventory of existing agroforestry practices and species, (3) a gendered valuation of agroforestry practices and species, and (4) the development of locally adapted and gender-sensitive agroforestry options. The research was complemented by a separate in-depth study on local environmental knowledge of agroforestry species that involved semistructured interviews with 38 local men and women. This separate study is not further detailed in this article.

Appraisal of social-ecological context and dynamics

We held a first workshop in the communities of Andina, Ccerabamba, and Pacchani in order to gain an understanding of the site's social and ecological context, including community members' perceptions of change. We asked groups of men and women to draw maps of their community as it exists now and existed 30 years ago (Figure 2). This visual material served as the basis for a discussion of the communities' current characteristics—including population, land use and vegetation cover, livelihood activities, and infrastructure. It also helped us to identify and discuss the main changes undergone during the last generation and the drivers of these changes. We captured perceptions of climate change and associated social, ecological, and economic impacts in timelines.

We then conducted a second series of workshops to assess the socioeconomic characteristics of the local population. Exercises included a classification of the population of each community according to wealth and status (as perceived by the participants) and the development of seasonal calendars of the main livelihood activities. Other workshop activities focused on gender roles and on perceptions of the empowerment of women. The exercises used in the first and second series of workshops were adapted from the work of Jost et al (2014). During this first phase, we complemented the workshops with walks across the 3 communities that allowed us to observe variations in land use and vegetation cover. We also carried out open-ended interviews with elderly men and women to collect narratives about the communities' history since the hacienda period, approximately 50–60 years ago.

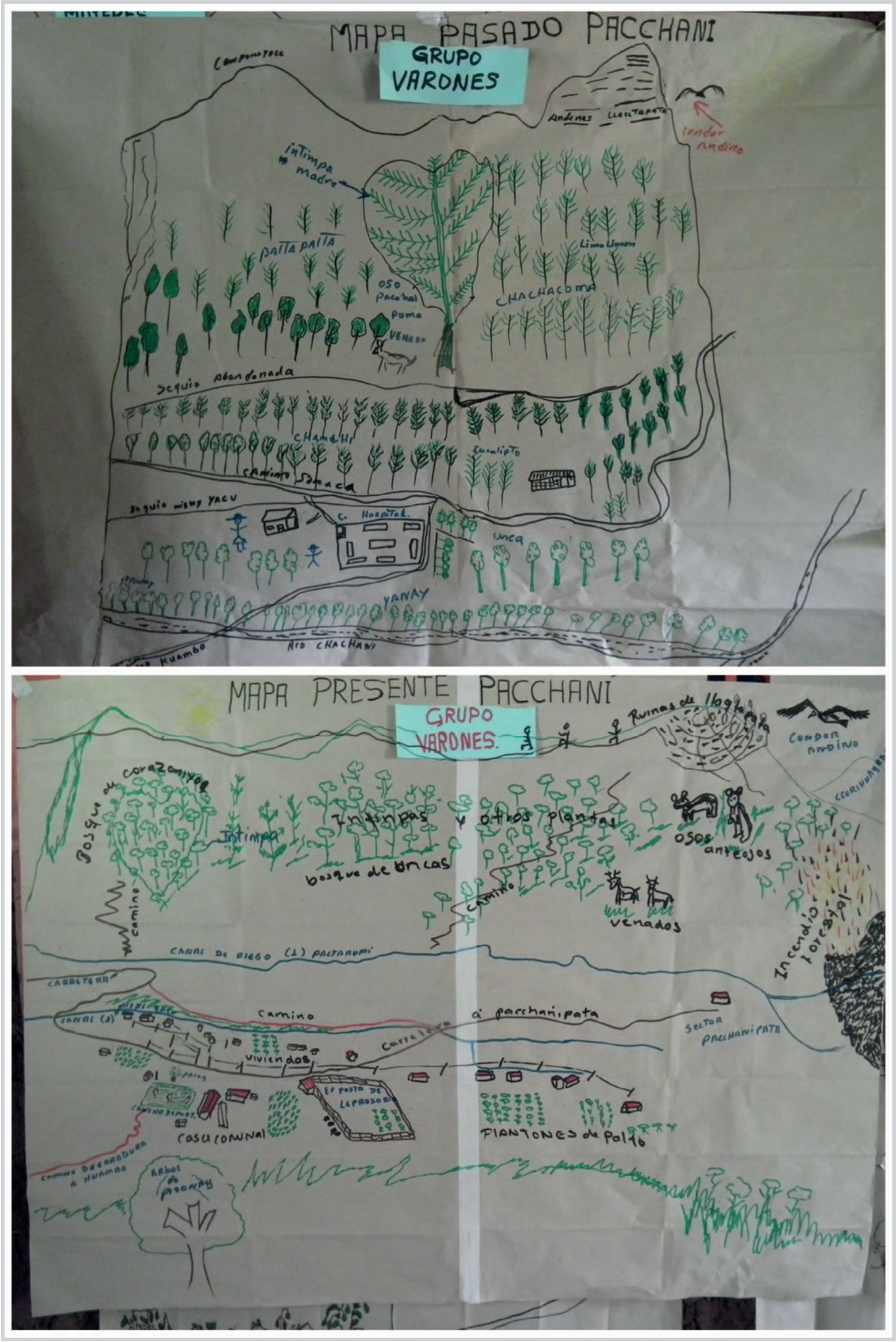
Inventory of agroforestry practices and species

During a third series of workshops, we explored local participants' livelihood activities and land uses in a more systematic way, quantifying the time that men and women spend in livelihood activities. To this end we used an exercise (Mulyoutami et al 2014) in which participants use simple props such as pebbles or seeds to indicate, for example, time spent on an activity or benefits of a specific practice (Figure 1). The results from the community of Pacchani can be seen in Figure 3. We then made an inventory of the agroforestry practices and species used in the 3 communities. To do so, we used available spatial data such as vegetation maps (PRONAMACHS 2007) and Google Earth satellite images to support group discussions on local concepts and terminology, land use categories, resource management, and agroforestry practices. In the field, we carried out semistructured interviews with farmers on specific agroforestry practices and species. We also collected voucher specimens of the agroforestry species mentioned during the interviews according to ethnobotanical standards (Martin 1995). These specimens were later identified at the herbarium of the Forestry Department of the National Agrarian University in Lima. We systematized the information from the workshops and field visits in land use and livelihood diagrams (Bangor University 2016), as illustrated in Figure 4. These diagrams helped us to visualize and revise our preliminary results in partnership with local participants during the subsequent research steps.

Gendered valuation of agroforestry practices and species

We conducted a fourth series of workshops to evaluate the perceptions of both men and women on the benefits of agroforestry practices. We first confirmed with the participants the list of agroforestry practices identified during Step 2. With the support of the Google Earth satellite images, we also confirmed the location in the community and the management characteristics of the agroforestry practices. We then asked the groups of men and women to rank the agroforestry practices from most to least important. Each group had to reach a consensus about this ranking, and the discussions and negotiations that led to these rankings were recorded (see Table 2 as an example). For the most important agroforestry practices, we asked the participants to value their different benefits based on a list obtained from the inventory in Step 2, again using the pebble exercise (Mulyoutami et al 2014). Figure 5 presents the outcome of one of these valuations. We ended the workshops by preparing a ranking of the 10 most important agroforestry species and documented the reasons given by participants for this ranking. During this research step, we also collected additional botanical specimens, for species for which samples had been missing or inconsistencies in previously recorded local names required clarification.

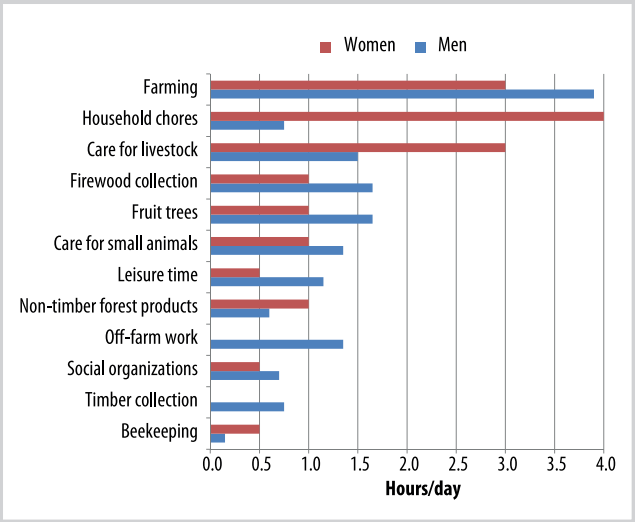
FIGURE 2 Results of a participatory mapping exercise by men from Pacchani, comparing the current situation (bottom) with the situation 30 years ago (top).



Development of agroforestry options

In each community we held a final workshop where we first presented and validated the results from Steps 1 to 3 with local participants (Valdivia-Díaz and Mathez-Stiefel 2015a, 2015b, 2015c) and then jointly analyzed options for the promotion and implementation of agroforestry practices. In addition to the community members, 3 professionals from the partner development program (2

FIGURE 3 Time spent by men and women on livelihood activities in Pacchani (based on a total of 15.5 working hours/day).



men and 1 woman) were invited to attend these workshops and provide technical information for local participants.

In contrast with the earlier workshops, these final workshops were carried out in mixed groups of men and women. However, we sought to ensure that all participants were able to express their views. We adapted the methodology for the analysis of agroforestry options from Smith Dumont et al (in press). We started by prioritizing agroforestry practices based on results from the previous research steps. We then analyzed each of these practices by examining its location in the community, its advantages and disadvantages, and its management requirements. The participants ultimately identified the actions needed for the promotion and implementation of each practice, as well as the people who could be responsible for these actions (Table 3).

Methodological considerations

Identifying locally adapted agroforestry options

The step-by-step integrated participatory process that we applied in our project enabled us to identify, in partnership with community members, context-specific and locally relevant agroforestry options (Mathez-Stiefel 2016). Interestingly, the agroforestry species mentioned during the companion study's semistructured individual interviews on local environmental knowledge were not always the same as those prioritized in this study's workshops, with stronger emphasis on native, as opposed to exotic, species in the workshops. For example, while the exotic pine tree (*Pinus radiata*) was frequently mentioned in the more conventional semistructured interviews because of its perceived function in increasing soil fertility and protecting against soil erosion, workshop participants prioritized *chilka* (*Baccharis salicifolia*) and *muña* (*Minthostachys mollis*) for the same agro-ecological functions. Similarly, exotic eucalyptus trees (*Eucalyptus globulus*) were most frequently mentioned in the semistructured interviews for their ability to function as windbreaks and to protect crops against heavy rains, whereas during the workshops, *capulí* (*Prunus cerotina*) and *intimpa* (*Podocarpus glomeratus*) were among the native species more favored for the same functions.

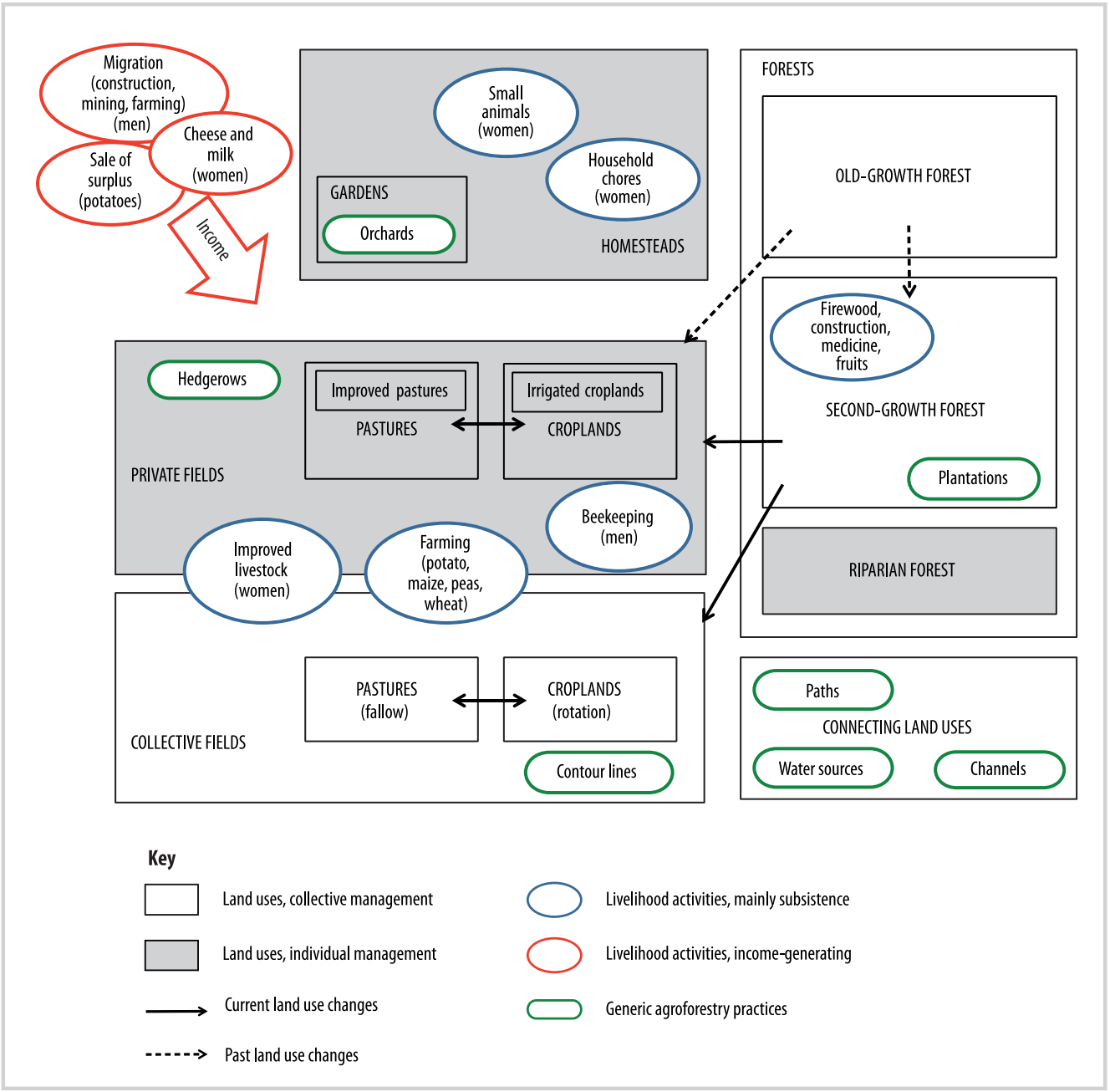
In our study, during the discussions leading to the selection of agroforestry options, workshop participants tended to prioritize species that already existed locally, required little additional labor or external technical knowledge, and had other positive features such as growing rapidly or not competing with crops. Furthermore, the prioritization of agroforestry practices based on their perceived current or future benefits reflected the visions of all local actor groups represented in the workshops, including men and women and younger and older farmers.

In this sense, we can conclude that the tools applied, by enabling a deliberative learning process between the diverse participants, can ensure that development recommendations are socially inclusive. Our results regarding both the increased focus on native species and the increased social inclusiveness of agroforestry options generated through a systems approach coupled with structured stakeholder workshops are in line with the findings of Smith Dumont et al (in press) in the eastern Democratic Republic of Congo. Similarly, in the mountains of North Korea, He et al (2015) have shown that the participatory selection of agroforestry species can help to include the differing preferences of individual resource users and better meet their livelihood needs.

Understanding the social-ecological system

In our study location, the application of an integrated systems approach, moving step by step from a broad understanding of the local context from the viewpoint of local actors (the social–ecological context and dynamics) to a detailed assessment of our specific topic of interest (agroforestry practices and species), was effective and appropriate. This is especially important in mountain areas, where high climatic, ecological, and social heterogeneity leads to very diverse livelihood and land use systems. Furthermore, focusing on a single component of the system, a common practice in applied research, would have undoubtedly led to an incomplete appreciation of the complexity of local agroforestry practices and a poor understanding of their relevance for local stakeholders. Van Ginkel et al strongly criticize such sectoral approaches, stating that they lead to interventions that "tend to rely on narrow perspectives, unrealistic extrapolations, untested assumptions and misapplied narratives, and have often failed to provide lasting benefits to rural households" (2013: 752).

FIGURE 4 Livelihood activities, land use categories, and agroforestry practices in Ccerabamba.



Adopting a systems approach was also culturally appropriate, as it corresponds much better with the Andean worldview, which integrates the natural, social, and spiritual spheres of life. This type of holistic ontology can be found in many other indigenous and traditional communities worldwide, as has been described by anthropologists and ethnoecologists (Posey 1999). Our adaptation and use of the participatory appraisal tools proposed by Jost et al (2014) helped us to rapidly acquire a comprehensive understanding of the local context and dynamics, social categorization, and livelihood and land use systems. It provided us with the information needed to orient the design of the next steps of the research and is thus recommended for scoping studies in similar mountain areas. However, equally important were the in-depth interviews and discussions in subsequent workshops. These allowed us to acquire a thorough qualitative understanding of gender relations and

TABLE 2 Perceived benefits of agroforestry practices in Ccerabamba (1 = most important, 10 = least important).

Land use	Generic agroforestry practice	Valuation by men		Valuation by women	
		Rank	Benefits	Rank	Benefits
Paths, channels and water sources	Woody vegetation by water sources	1	Produces water	1	Protects the water; provides humidity, shade, and medicinal plants
	Woody vegetation along irrigation channels	4	Retains humidity; provides shade	2	Stabilizes the banks of the channels; provides shade; keeps the water cool for the livestock; provides medicinal plants
	Hedgerows along paths	10	Provides firewood and construction wood; protects from landslides	10	Protects the fields from landslides; provides shade on the paths
Homesteads	Fruit orchards	6	Provides food; provides income through sale and barter	4	Provides food, income through sale or barter, medicinal plants, and firewood and wood for tools
Fields	Woody vegetation along contour lines	5	Delimits the plots	7	Protects the croplands from erosion; provides medicinal plants
	Hedgerows on field boundaries	9	Delimits the plots; protects the crops from the livestock	5	Delimits the plots; protects the crops from the livestock; provides medicinal plants and flowers for the bees
Forests	Riparian woody vegetation	3	Stabilizes the riverbanks; provides shade	3	Stabilizes the river banks; provides shade, firewood and wood for tools, food for wild animals, and medicinal plants
	Old-growth forest	2	Produces and retains humidity; purifies the air	9	Produces fog and humidity; purifies and cools the air; provides medicinal plants; is home to wild animals
	Small-scale tree plantations	8	Provides firewood and construction wood (however, eucalyptus trees damage the soil)	6	Provides firewood and construction wood; provides income through sale
	Second-growth forest	7	Purifies the air; provides medicinal plants	8	Provides medicinal plants, fruits for people and wild animals, and firewood

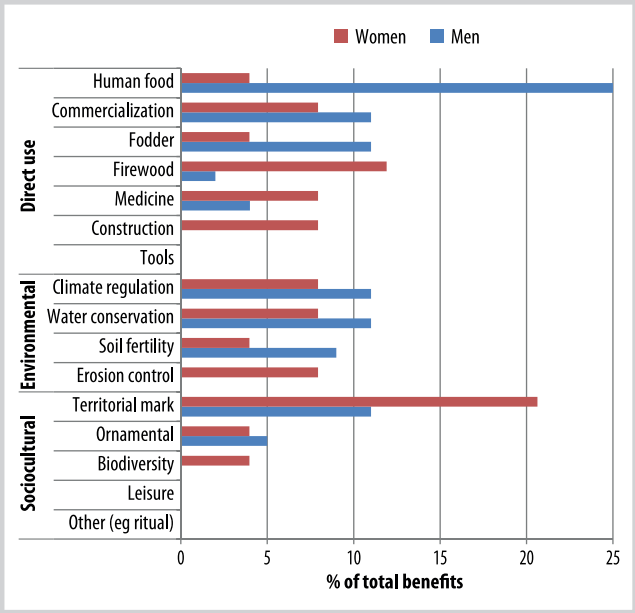
dynamics and thus overcome some of the shortcomings encountered by colleagues who have relied solely on participatory tools for gender research (Jost et al 2015).

Facilitating a social learning process

Our study's iterative design along a sequence of carefully facilitated participatory workshops enabled a social learning process between the researchers and the diverse social groups that comprise the local communities. These groups included women and men of all ages and with differing socioeconomic statuses and levels of involvement with local organizations and the associated power and authority. In this respect, according to Rist et al (2006), social learning is an extremely powerful approach, as it makes it possible to move from the management to the governance of natural resources. It does so by providing a space for societal debate, in which the actors can negotiate local norms, rules, and power relations related to natural resource use and sustainable development (Rist et al 2006: 23).

In our project, we witnessed how agroforestry options emerged based on the elicitation, discussion, and negotiation of men's and women's distinct perceptions of their community context and valuations of agroforestry practices and species. Indeed, the richness of our research

FIGURE 5 Valuation by men and women of the benefits of hedgerows on field margins in Andina (based on a list of benefits of agroforestry practices previously defined with the participants).



approach lies as much in the learning process and the discussions generated by the participatory exercises as in their results (eg the deliberations generated by a ranking exercise led to a discussion on the benefits of agroforestry species). This type of research process is transformative per se, as local participants learn new ways of interacting with outsiders. Local men and women are empowered by becoming sources of knowledge and agents of change instead of mere recipients of information and beneficiaries of interventions, as typically occurs in more conventional extension approaches. During the workshops, local participants were amazed to see how they could analyze their own reality with simple tools and materials. The research process also raised their self-esteem, as their natural resources, knowledge, and opinions were valued by other community members and by external researchers alike.

Another aspect of the research tools described in this paper is that they require interpersonal and facilitation skills as well as excellent knowledge of the local context and culture. This has also been highlighted by other researchers working with participatory gender tools (Jost et al 2015). In our case, a successful strategy was to include in the research team a number of local participants who were well accepted in their communities. These local community members played an important role not only by translating the exercises and concepts into Quechua, but also by adapting them to the local context. We recommend not only revising and adapting the workshop exercises with the local facilitators, but also going a step further to practice them in advance with the team. This enables the local facilitators to direct and lead the workshops both in the local language and in culturally appropriate ways. Another lesson from our study is that although splitting groups according to sex is often recommended, some exercises, such as the identification and analysis of development options, can yield better results if conducted in mixed-sex groups. Schwilch et al (2009, 2012) have also successfully used such multistakeholder learning tools to identify and select promising options for sustainable land management in desertification-prone sites.

Engaging in gender research

Engaging in gender-transformative research implies giving women a voice and challenging existing norms and power relationships. However, many constraints may limit women's participation in the research process, as we experienced in our project. First, women's work responsibilities often leave them little time to participate in additional activities. In many mountain areas, while women share livestock and other agricultural responsibilities with men, they also have many additional domestic tasks. As Wymann von Dach (2002) explains, this is especially the case in mountain areas, where the rough topography and great distances, combined with the absence of men who have outmigrated, increases the workload of women.

Second, women (in particular middle-aged and elderly women) generally have a low level of formal education and are less fluent in Spanish than men and thus have more difficulty in participating in exercises that involve writing—hence, for our study, the importance of conducting the exercises in Quechua.

Third, Andean women are often shy; they are not used to speaking in public and have a low level of self-assurance, which inhibits their participation in workshops and meetings with outsiders. Also, as community meetings are largely attended by men, local authorities (who are generally also men) do not take into account the availability of women when organizing activities. They typically set up workshops during the day, when women are busy with chores. It is therefore crucial to openly discuss with local authorities and community members the importance of involving women in the research process, the constraints that are faced in attempting to do so, and ways to overcome these constraints.

Simple concrete measures can be taken to increase women's involvement in the research process, such as scheduling research activities to match women's availability and preferences. We also recommend complementing the information from the workshops with individual interviews and accompanying women in their daily activities. In our experience, female community leaders can play a significant role in encouraging other women to participate in research activities, and we therefore highlight the importance of identifying and engaging these trusted women as local research

TABLE 3 Analysis of prioritized agroforestry practices in Andina. (Table extended on next page.)

Agroforestry practice	Location	Advantages
***Pisonay* (*Erythrina falcata*) for water conservation**	By rivers and water sources	• Stores water in trunk and conserves soil moisture • Provides firewood and wood for construction and tools • Provides fodder for guinea pigs and livestock • Ashes can be used for chewing coca leaves • Flowers provide food for honeybees and parrots • Sprouts and grows quickly
***Chilka* (*Baccharis salicifolia*) for protection against soil erosion**	Croplands and pastures (on upper slopes and scattered)	• Abundant roots and stems protect the fields from landslides • Leaves fertilize the soils • Medicinal plant • Flowers provide food for honeybees • Used to prepare *ccora* (germinated maize used to make *chicha*, a fermented drink) • Grows quickly
***Muña* (*Minthostachys mollis*) to increase soil fertility**	Croplands and pastures (on upper slopes)	• Leaves and stems fertilize the soil • Decomposes quickly • Medicinal plant • Herbal tea • Protects harvested crops from worms • Provides fodder for sheep
***Romerillo* or *intimpa* (*Podocarpus glomeratus*) for protection against heavy rainfall**	Slopes covered by second-growth forests	• Numerous resistant stems protect from heavy rain and landslides • Resistant to drought and heat • Precious wood • Provides firewood and tools • Stems with spines used for living fences • Ornamental • Sprouts easily

facilitators. Young people should also be involved as much as possible. For example, teenage girls often have much higher levels of education than their mothers, and they can motivate their elders to participate and help them realize some of the research exercises.

We also highly recommend engaging women as active members of the research team. This is important because women participants may feel more comfortable discussing sensitive issues, such as decision-making processes within the household, with other women. For this reason, it is fundamental to provide an exclusive space for women to engage in the research process, as they may be inhibited by the presence of men. This can be easily achieved by working with men and women in separate groups or separate interviews. In the words of one of the local facilitators, working this way allowed "each of the groups of women and men to participate [in the process] and to contribute with its own way of thinking and feeling."

Equally important is providing an opportunity for local men and women to jointly reflect on the study's results. As stated above, research conducted as a social learning process is transformative per se and can challenge existing power relations. In our case, for example, the participants' collective reflection on the empowerment of women in the communities increased their awareness of women's lack of participation in community decision-making and options for changing the situation.

Establishing ethical collaborations

The last point we wish to make relates to research ethics. Conducting research for development, or going further by embedding research in development programs (Coe et al 2014), requires collaborating with a range of nonacademic partners including local community members, development organizations, and government bodies. The way researchers develop these collaborations is crucial both for the quality of the research and for its social legitimacy. The Swiss Commission for Research Partnerships with Developing Countries has developed 11

TABLE 3 Extended. (First part of Table 3 on previous page.)

Agroforestry practice	Disadvantages	Management considerations	Proposed actions (actors)
***Pisonay* (*Erythrina falcata*) for water conservation**	• Roots damage irrigation channels • Takes space that could otherwise be planted to crops • Is spiny • Wood is soft	• Grows on any type of soil, including in dry areas • Propagation by seedlings or cuttings • Needs to be watered 3–5 times before it is well established	• Collect and plant cuttings (community) • Build technical capacity (national or regional extension service, NGOs)
***Chilka* (*Baccharis salicifolia*) for protection against soil erosion**	• Livestock gets caught in its stems • Takes space that could otherwise be planted to crops	• Grows on any type of soil • Spread by wind • Seedlings should be planted during the rainy season	• Plant seedlings on the boundaries of croplands (individual farmers)
***Muña* (*Minthostachys mollis*) to increase soil fertility**	• Can spread further than desired	• None (grows spontaneously)	• Allow to grow on contour lines and boundaries of croplands and pastures (individual farmers) • Prepare compost with leaves (individual farmers)
***Romerillo* or *intimpa* (*Podocarpus glomeratus*) for protection against heavy rainfall**	• Grows slowly • Creates excess shade in crop areas	• Grows on black soil • Seedlings should be planted during the rainy season • Spontaneous sprouts can be transplanted	• Reforest steep slopes (community) • Protect existing trees, and plant additional trees (community) • Establish pilot project to develop propagation techniques (NGOs and local governments)

principles for ethically engaging in transboundary and intercultural research (Stöckli et al 2012): (1) setting the agenda together, (2) interacting with stakeholders, (3) clarifying responsibilities, (4) accounting to beneficiaries, (5) promoting mutual learning, (6) enhancing capacities, (7) sharing data and networks, (8) disseminating results, (9) pooling profits and rewards, (10) applying results, and (11) securing outcomes.

In our experience, transparency and honesty are fundamental to the application of these principles. The extended community-level participatory processes described in this paper can raise local participants' expectations, and it is important to maintain an open and transparent dialogue on the research project's objectives, its activities, and the benefits that it will generate. Researchers should always be mindful of the time and other commitments they ask of their local collaborators and ensure they will be compensated with research outputs that correspond to their interests and needs. In our case, products ranged from research reports to booklets on agroforestry practices and presentations at local schools.

Another key aspect is to respect local communities' organizational structures and dynamics, including both formal and informal institutions such as community-based organizations, committees, churches, schools, and traditional leaders. We made sure to organize the research activities through locally recognized authorities, even though it was on some occasions more complicated and time-consuming than engaging directly with community members.

Conclusions

The research methodology that was developed and applied in this study is especially recommended for the exploratory phase of natural resource management initiatives in mountain areas. In these settings characterized by high environmental and sociocultural variability, we argue, integrated transdisciplinary tools are

needed to design socially inclusive and locally adapted natural resource management options. Our research approach could, however, be easily adapted to other settings, provided that the methodological steps and principles are respected.

According to the Future Earth platform, research for global sustainability requires a novel way of doing science that focuses "on the full integration among scientific disciplines, on engagement with societal partners in co-designing and co-producing knowledge, on international collaboration, on producing knowledge that is valuable to decision-makers, and on generating the solutions that society needs" (Future Earth 2014: 9). The research approach we have presented here fully responds to this plea. It also responds to the call for approaches that contribute to transforming development pathways by helping "balance the economic and non-economic values of biodiversity and ecosystem services" (Future Earth 2014: 25). It does so by providing the tools needed to capture local stakeholders' perceptions on the valuation of natural resources.

One of the key insights from our study is the importance of social learning processes for development-oriented research. Development projects should ensure provision of the time and resources needed for these types of participatory research methodologies. In addition, the recognition and promotion of colearning mechanisms implies a shift from a primarily outcome-oriented to a process-oriented programmatic approach. It is thus our hope that donors will be increasingly demanding of the way research and practice are conducted, and supportive of the learning processes needed to contribute to truly transformative natural resource management interventions.

ACKNOWLEDGMENTS

The first author designed and conducted the study in the framework of a post-doctoral fellowship with the World Agroforestry Centre (ICRAF). The other coauthors, listed in alphabetical order, contributed to the facilitation of workshops, data collection, and preliminary data analysis. The authors' deep appreciation goes to the members of the communities of Andina, Ccerabamba, and Pacchani for their active participation in the project. The Andean Forest Program, financed by the Swiss Agency for Development and Cooperation (SDC), and its implementing organizations, Helvetas Swiss Intercooperation and the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN), are acknowledged for logistical support. Professor Carlos Reynel of the National Agrarian University La Molina is sincerely thanked for the identification of botanical voucher specimens, as well as 2 anonymous reviewers for their time and valuable comments. All donors who supported this research through their contributions to the CGIAR Fund (www.cgiar.org/who-we-are/cgiar-fund/fund-donors-2/) are also acknowledged.

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