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RESEARCH ARTICLE

Partnering with cattle ranchers for forest landscape restoration

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Abstract Transforming Latin America's extensive grazing systems is critical for forest landscape restoration (FLR) but conservation initiatives rarely make efforts to include cattle ranchers. Engaging ranchers requires understanding their perceptions about how improved management and conservation practices fit into their overall production strategy. To assess ranchers' motivations and limitations for adopting conservation-friendly practices, I surveyed 191 ranchers and extension agents participating in a silvopastoral project in Colombia. I found that ranchers are integrating multiple practices they perceive as complementary for achieving their goals: practices aimed at improving productivity are motivated by utilitarian values, while practices targeting environmental degradation and climate change are driven by stewardship and identity values. Input costs and labor shortages currently limit the expansion of conservation-friendly practices, but in-kind support and small cash payments could potentially alleviate these barriers. Silvopastoral ranchers can be instrumental partners in FLR provided that initiatives are designed with their perspectives in mind.

Keywords Climate change · Conservation-friendly agriculture · Extension agents · Forest landscape restoration (FLR) · Payments for ecosystem services · Silvopastoral systems

INTRODUCTION

Agricultural expansion and intensification have transformed natural ecosystems at a global scale, contributing to climate change, biodiversity loss, land degradation, and water pollution (Ramankutty et al. 2008). Many governments now recognize the need to repair or mitigate damaged ecosystems, and have committed to restoring millions of hectares of degraded landscapes. Poorly planned large-scale restoration projects, however, can displace existing land uses and further drive the expansion of the agricultural frontier (Meyfroidt et al. 2010; Latawiec et al. 2015). To avoid this risk many countries are designing restoration projects to accommodate multiple uses—agricultural production, biodiversity conservation, and the provision of ecosystem services—on the same landscape, an approach known as Forest Landscape Restoration (FLR) (Mansourian and Vallauri 2005; Lamb 2014). FLR aims to regain ecological functionality and strengthen human livelihoods in regions that are already deforested and degraded by combining a variety of strategies including ecological restoration of critical areas, sustainable agricultural practices on productive lands, and increased tree cover across the landscape (IUCN and WRI 2014). Tailoring these strategies to the specific biophysical conditions of the landscapes, and especially, the needs and preferences of the people who inhabit them is critical for the long-term success of FLR (van Oosten 2013).

Managed grazing lands already occupy more than 25% of the Earth's surface (Asner et al. 2004). In Latin America and the Caribbean, pasturelands continue to expand at an alarming rate primarily at the expense of native forests and other species-rich ecosystems (Gibbs et al. 2010; Graesser et al. 2015). Removal of native vegetation cover, mismanagement of soil and water resources, and persistent

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overgrazing have resulted in low average cattle productivity (0.59 head ha^{-1}) (FAO 2006) and widespread degradation (Steinfeld et al. 2006). Given the vast areas of tropical forests already converted to pasture, improving productivity on the existing degraded lands presents prime opportunities for FLR in Latin America, provided that intensification is achieved through sustainable methods and that supporting policies are put in place to prevent the clearing of new lands (Latawiec et al. 2015). In Brazil's Atlantic Forest region, for example, improving pasture productivity on the best lands could spare up to 18 million hectares without compromising future agricultural output (Strassburg et al. 2014). If sustainable agricultural practices are used to achieve higher productivity using less land, and the spared lands are designated for restoration or rehabilitation, significant advances in FLR could be achieved in one of the world's most biodiverse regions (Latawiec et al. 2017).

One alternative to produce cattle more sustainably is the use of silvopastoral systems, or multifunctional agroforestry arrangements that combine livestock, forage species, and trees to provide animal feed and complementary goods and services. At the farm scale, silvopastoral practices can enhance productivity, animal welfare, soil retention, and carbon sequestration (Dagang and Nair 2003; Mcadam et al. 2007; Murgueitio and Ibrahim 2008; Amézquita et al. 2010; Murgueitio et al. 2011; Broom et al. 2013); they are also more conservation-friendly because they rely less on external inputs and more on increasing structural complexity to facilitate biological processes. Scaled across the landscape, silvopastoral systems can increase total tree cover enriching the agricultural matrix and re-creating connectivity (Harvey et al. 2008). Therefore, in regions where the replacement of species-rich native forests with extensive pastures has resulted in high degradation and low productivity, implementing silvopastoral systems can allow ranchers to increase productivity on the best lands while setting aside more fragile areas for conservation, thereby contributing to FLR and rendering benefits to both individual ranchers and to society (Murgueitio et al. 2011; Latawiec et al. 2015).

Silvopastoral practices, however, imply a radical departure from the extensive production model that prevails in Latin America, which may explain why their adoption remains limited. Efforts to scale up silvopastoral systems in the region have emphasized their impact on productivity and profitability, and there is a good understanding of how ranchers respond to financial incentives for adoption and what economic and productive benefits they perceive from these practices (Calle et al. 2009; Frey et al. 2012; Garbach et al. 2012; Hayes 2012; Lerner et al. 2015). What is lacking is an examination of ranchers' interest in adopting conservation practices that do not necessarily render direct economic benefits and, in some cases, may entail additional costs (e.g., riparian forest recovery). This gap in knowledge is not surprising given that tropical cattle ranching and conservation have long been considered incompatible, and that ranchers are typically regarded as poor land stewards and rarely included in conservation initiatives (Hecht 1993; Steinfeld et al. 2006). In some developed countries where conservation programs have actively targeted ranchers, their participation has been linked to an individuals' place attachment, stewardship and identity values, and attitudes toward conservation, whereas financial incentives, although desirable, tend to be a less important motivation (Greiner et al. 2009; Farmer et al. 2011; Sorice et al. 2012; Brain et al. 2014). However, these findings are not necessarily applicable in the developing world where ranchers face other challenges and their motivations for engaging in conservation may be entirely different.

Silvopastoral systems are increasingly being promoted as a FLR strategy in Latin America's degraded grazing landscapes, but the success of this strategy depends on: (1) ranchers' voluntary participation at a regional scale, and (2) ranchers' adoption of the full range of conservation-friendly practices, from the sustainable management practices focused on productivity to the conservation-oriented practices focused on environmental protection. Reasons for engaging in the first are relatively well known, but evidence-based insight about tropical ranchers' interest in the latter is missing. This knowledge is critical to design programs that address the wide range of motivations, incentives, and barriers perceived by ranchers, and therefore to achieve widespread participation in FLR programs.

To address this knowledge gap, I conducted parallel surveys with ranchers and extension agents who are currently participating in a national-scale silvopastoral project in Colombia. Ranchers and extension agents work closely to implement conservation-friendly practices selected by the rancher, which range from pasture division and rotation, to the protection and recovery of riparian buffers. While ranchers who voluntarily participate in this project are not necessarily representative of all ranchers, they do face many of the same challenges and their perceptions about conservation-friendly practices can help inform strategies to achieve broader participation. Extension agents, on the other hand, can provide first-hand information about ranchers' general response to the practices. The objective of this study was to provide insight on how ranchers perceive and use different conservation practices and what motivates their preferences, and to understand how existing and potential barriers and incentives interact to shape these choices. This paper is an empirical contribution to understand the potential role of tropical cattle ranchers in conservation, and to inform the design of more

effective policies and strategies to scale up FLR in Latin America's degraded landscapes.

MATERIALS AND METHODS

Study site

The study was conducted within the Mainstreaming Sustainable Cattle Ranching (MSCR) project (http://ganaderiacolombianasostenible.co/web/) which is being implemented in Colombia since 2010. MSCR spans 12 states across five regions of the country, all of which are currently dominated by extensive pastures but were once native forests of high conservation value (Figure S1). The project aims to facilitate adoption of diverse conservation-friendly practices with three specific goals: (1) to increase cattle productivity, (2) to reduce land degradation and enhance landscape connectivity, and (3) to improve the delivery of critical environmental services. MSCR provides on-farm technical assistance to all ranchers, and short-term Payments for Ecosystem Services (PES) to those who adopt specific land uses that benefit biodiversity and/or carbon sequestration. The PES incentive includes in-kind support and partial reimbursement of specific implementation costs, but ranchers are expected to assume some expenses. In-kind support refers to items provided directly by the project and required for immediate implementation (e.g., cost-sharing for materials and labor, equipment loans, seedlings) as well as those needed later to ensure the long-term survival of the planted material (e.g., labor and inputs to maintain trees and fences). So far MSCR has reached more than 2800 ranchers; transformed more than 50 000 hectares of formerly extensive pastures into silvopastoral systems by adding trees, fodder hedges and live fences; and protected over 12 000 hectares of existing and recovering forests (J.C. Gómez, pers. comm.). Whereas these figures are small relative to the country's total pasture area, the project has demonstrated that production and conservation goals can be aligned, and more importantly, that many ranchers are willing to try alternative production systems.

Survey design, data collection, and analysis

This study consisted of two surveys: one for ranchers in which they were asked about their personal experiences and perceptions of conservation-friendly practices, and one for extension agents, in which agents were asked to assess their perceptions about the group of ranchers whom they work with. Extension agents' assessments of ranchers' perceptions, although subjective, are based on close working relations with individual ranchers over recent years and are useful to validate the reliability of ranchers' survey responses. Both questionnaires included five similar sections: (1) rancher and farm information; (2) current conservation-friendly practices; (3) motivations, barriers, and incentives for adopting conservation-friendly practices; (4) climate change; and (5) environmental values (Appendix S1). To avoid unnecessary confusion, the broad term "environmental protection actions" was used in the questionnaires to refer to both production-oriented and conservation-oriented practices. Questionnaires consisted mostly of closed-ended (i.e., yes/no, multiple choice, rate agreement with a statement, rate items by importance) and brief follow-up questions. Questionnaire design was based on preliminary semi-structured interviews and pilot tests with each group.

I surveyed 90 silvopastoral ranchers and 101 extension agents between June and September 2017. I conducted rancher surveys in-person during farm visits or field-training events in some of the project regions, but given the geographic spread of the project, other regions were underrepresented in the final rancher sample (Table S1). To correct for this sampling bias I used the extension survey, which was completed online by 100% of extension agents from all regions covered by the MSCR. In addition, I conducted 30 farm visits and 65 in-person, open-ended interviews with ranchers, extension agents, and key informants including practitioners, scientists, and government officials.

After tallying the results, I validated the consistency of ranchers' and extension agents' responses with the practices and values observed during field visits and extended interviews. I used X^2 tests to identify key differences in the perceived motivations, barriers, and potential incentives for adoption. I focus on ranchers' responses in the main text and present both groups' responses in the tables and figures. I draw from interviews and farm visits to explain any noteworthy discrepancies between groups.

RESULTS

Surveyed ranchers were primarily male, 40 to 60 years old, and all had legal tenure of their farms, which were mostly 50 hectares or less. In addition to cattle, over half of the ranchers were also growing cash or subsistence crops or had other farm-related activities such as agrotourism services. All ranchers were either currently enrolled in the MSCR (85%) or participants from previous projects, but few (15%) had used silvopastoral practices for more than 6 years (Table S1). This sample broadly reflects the country's cattle rancher population, which is comprised of 82% small and medium ranchers (Fedegan 2013).

Extension agents generally described the five project regions as largely deforested with some remaining forest fragments, medium to low connectivity, visible signs of erosion, and dominated by croplands and pastures. More than half of the ranchers reported having springs, creeks, wetlands, and riparian buffers on their farms, as well as soil erosion problems, while less than one-third had forest fragments.

The most widely adopted production-oriented practices reported by ranchers were dividing pastures for rotation, planting trees scattered in pastures and in live fences, and planting fodder banks (Table 1). The preferred conservation-oriented practices were planting or protecting trees throughout the farm, protecting forests and riparian buffers, reducing the use of agrochemicals (e.g., fertilizers, veterinary products), and restricting cattle access to streams. Following the implementation of changes, ranchers reported noticing a higher abundance of birds and wildlife, increased fodder quality and quantity, improved animal health and condition, more stable production, and reduced consumption of chemical inputs (Table 1).

Table 1 Silvopastoral and conservation practices currently being implemented by cattle ranchers, and changes perceived following implementation. Extension agents' responses reflect the number of agents who estimate that 50% or more of their ranchers are implementing or willing to implement the practice. For (a) and (b) $n = 90$ ranchers, 98 extension agents; for (c) $n = 82$ ranchers

	Ranchers (%)	Extension agents (%)
a. SPS currently implemented in productive areas of the farm		
Pasture division	83	37
Scattered trees	80	45
Live fences	79	79
Fodder banks	57	47
Intensive SPS	43	56
Fodder hedges (fodder shrubs + trees)	34	39
b. Conservation practices currently implemented anywhere on the farm		
Plant trees in pastures and live fences	96	98
Protect/recover forest fragment	92	87
Protect/manage natural regeneration	88	86
Protect/reforest riparian buffer	83	86
Reduce use of agrochemicals	86	86
Restrict direct cattle access to streams	73	75
c. Changes noticed after implementation of new practices		
Increased presence of birds/ wildlife	91	
Increased fodder quantity/quality	90	
Improved animal health/body condition	90	
More stability of production	87	
Reduced use of external inputs	61	

Rancher motivations for engaging in conservation-friendly practices

Ranchers' top motivations for adopting different silvopastoral systems were improving cattle productivity, protecting the environment, accessing technical assistance, and recovering soil fertility. On the other hand, ranchers considered the PES incentive as the least important motivation whereas extension agents gave it much more importance, ranking it in second place (Fig. 1) (Table S2). Ranchers planted trees in various parts of the farm specifically to provide shade for cattle, to improve fodder quality and quantity, and to protect the environment. When selecting trees to plant, they favored timber, fast-growth, native, and *N*-fixing species, but they were generally open to planting any trees provided (Table 2).

Ranchers had similar motivations for protecting forests and riparian buffers: conserving wildlife, preserving water quantity or quality, and protecting the environment were the most important (Fig. 2) (Table S2). Extension agents, however, assigned significantly less importance to wildlife protection. Ranchers ranked PES and monetary incentives as the least important motivations, while extension agents considered them as key factors for forest and riparian buffer protection (Table S2).

Ranchers' assessment of the value statements presented to them was highly consistent with their expressed motivations and observed practices. On one hand, they strongly agreed with statements such as "Trees provide direct benefits for production", which reflect utilitarian values. On the other, ranchers also identified with statements like "As a farmer, I am responsible for protecting the environment" or "I feel a strong emotional tie to my land", which suggest an interest rooted in a broader set of personal values. Other statements like "Environmental protection has high costs but few benefits" elicited more divided reactions, underlining an awareness of the trade-offs between conservation and production (Table S3).

Climate change

All ranchers perceived changes in the local climate and most had voiced their concerns to extension agents (Table 3). Although specific changes in weather patterns

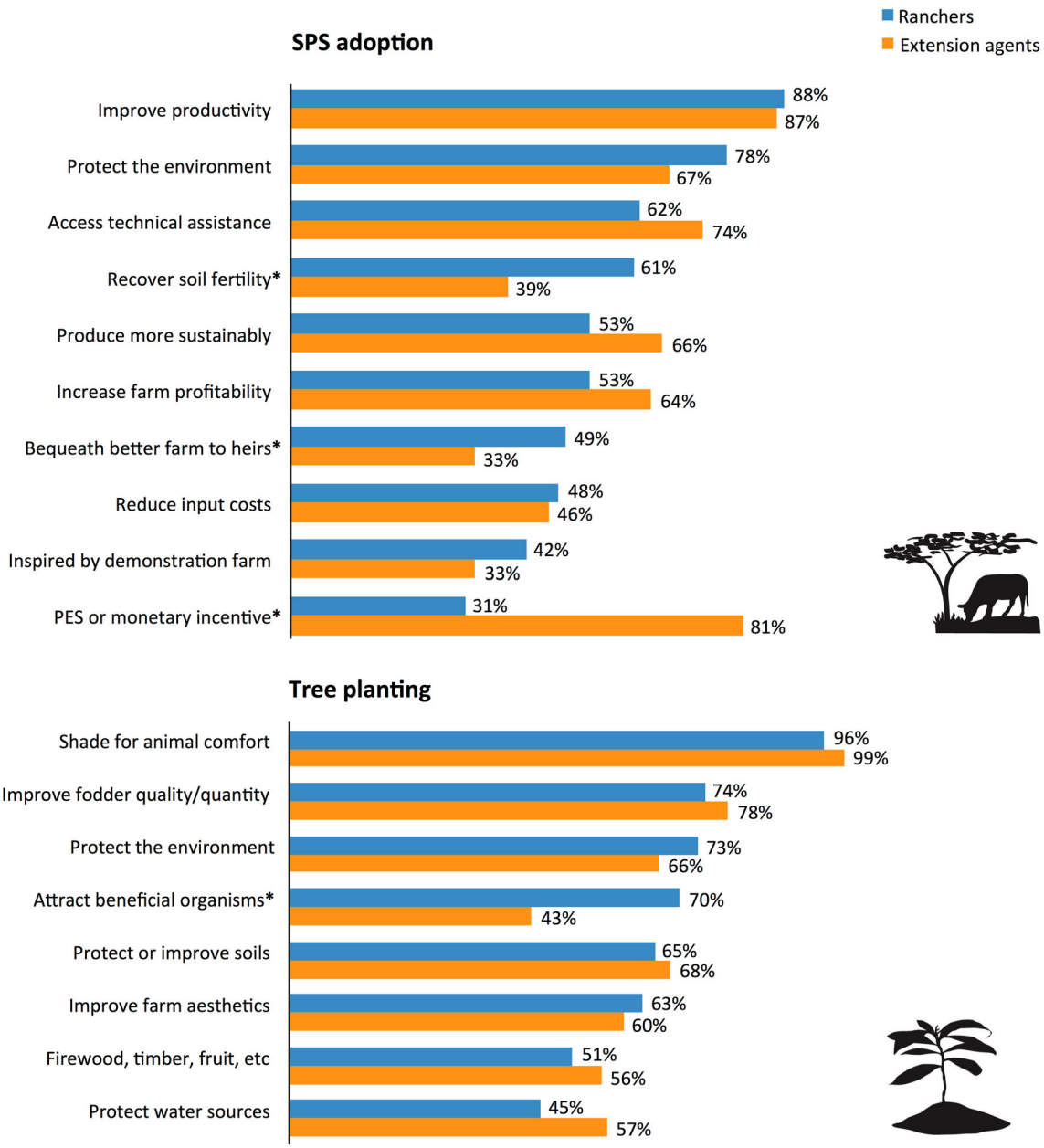

Fig. 1 Cattle ranchers' motivations for adopting silvopastoral systems (top) (n = 90 ranchers, 98 extension agents) and specifically, for planting trees in pastures, live fences and riparian buffers (bottom) (n = 89 ranchers, 97 extension agents). Items are listed from most to least important according to ranchers. Extension agents' responses reflect the estimated importance of the item among their group of ranchers. (*) Significant differences between ranchers and extension agents (X^2, $P < 0.05$)

varied across regions, higher than usual temperatures, increasing weather variability, and more intense seasonal events were noticeable nationwide. Roughly two-thirds of ranchers perceived these as negative for production. However, all ranchers were confident that their newly adopted practices could contribute to mitigate climate-related impacts by providing a variety of services including climate regulation, environmental conservation, soil protection, and stabilizing production (Table 3).

Barriers and incentives for scaling-up

Ranchers identified high input costs and labor shortages as the main barriers preventing the implementation of more changes (Fig. 3), and extension agents agreed with this assessment. Input costs include those associated with buying seedlings, fertilizing young trees, transporting materials, site preparation, fencing, general equipment, and labor. Labor shortages were common across all regions, especially those that specialize in cash crop production.

Table 2 Cattle ranchers' preferred types of trees to plant on the farm, and list of "Other" desirable traits mentioned. Extension agents' responses reflect an estimate of the trees most frequently planted or requested by their group of ranchers. For (a) $n = 88$ ranchers, 96 extension agents. Items in (b) are traits free-listed by respondents under "other"

	Ranchers	Extension agents
a. Preferred types of trees to plant		
Timber trees	82%	97%
Rapid growth trees	75%	97%
Native trees	74%	81%
Nitrogen fixing trees	71%	73%
Attract wildlife trees	64%	60%
Good shade for cattle trees	59%	47%
Fruit trees	55%	60%
Flowering trees	46%	33%
b. Other traits favored by ranchers when selecting trees		
Flowers that attract pollinators	Small leaves for optimal shade	
Rapidly decomposing litter	Quick to regenerate or re-sprout	
High survival rate after planting	Grow in arid or eroded areas	
Exotic trees	Endangered species	
Good as windbreaks	Good for the environment	
Deciduous trees	Good for shading coffee	
Trees provided to me	A mix of different trees	

Maintenance requirements and high tree mortality were also impediments. Ranchers were much less concerned about lack of technical assistance and information, competition between trees and pastures, or the potential permits required or fines incurred for future tree harvesting (Table S4).

Ranchers expressed interest in scaling-up conservation-friendly practices and identified in-kind support as the most effective incentive to overcome the key barriers, giving less importance to the PES incentive (Fig. 3). Extension agents agreed with the need for more in-kind support, but considered that providing PES, tax breaks, and other monetary incentives would be as effective to scale up conservation practices (Table S4).

DISCUSSION

This study confirms that farmers are not guided exclusively by profit maximization and that personal and environmental concerns also play a role in cattle ranchers' decision-making (Greiner et al. 2009; Farmer et al. 2011; Sorice et al. 2012). Ranchers favored practices expected to directly improve productivity and reduce ongoing costs, and selected low-cost options (e.g., live fences) over those requiring higher investments (e.g., cattle watering systems). At the same time, they embraced conservation practices that carried significant opportunity costs (e.g., permanently eliminating grazing in riparian buffers) and no direct financial return. Ranchers appear to have adopted practices based not on whether they were production or conservation-oriented, but on whether or not the practices could help them address growing concerns over declining productivity and land degradation. The fact that demand to participate in the MSCR project far exceeded its capacity (J.C. Gómez, pers. comm.) suggests that more ranchers are willing to introduce changes that would make their cattle production systems more conservation-friendly. Given the 39.2 million hectares of land currently used for pasture in Colombia (Fedegan 2013), the potential to engage more ranchers in conservation through silvopastoral systems could be significant. Assumptions about ranchers' disregard for nature must therefore be re-examined as ranchers could be instrumental partners for the transformation of the existing extensive production model.

One key result of this study that underscores the need for a more empirically based understanding of ranchers' perceptions is that most ranchers have a substantial interest in protecting and planting more trees on their farms, especially in pastures. By contrast, previous studies found that while ranchers in Panama and Ecuador recognized many benefits of trees and actively managed and protected trees and natural regeneration, they rarely planted them intentionally in pasture areas (Garen et al. 2011; Lerner et al. 2015). Similarly, Brazilian ranchers had little interest in actively incorporating trees in grazing areas, even as they were implementing other forms of improved pasture management (Latawiec et al. 2017). This widespread reluctance stems from the belief that trees and pastures are incompatible, a misconception that Argentine silvopastoral ranchers rapidly overcame as they learned proper shade-management techniques to optimize pasture growth (Frey et al. 2012). Ranchers in this study moved past initial concerns about pasture productivity and were now focusing on the multiple benefits of trees, especially for animal welfare. Technical assistance and experimentation can facilitate the cultural change needed for ranchers to embrace tree planting (Calle et al. 2013); failing to fulfill the need to guide and assist ranchers may result in missed opportunities for FLR.

Although changes in weather patterns varied across regions, all cattle ranchers in this study experienced extreme temperatures and unpredictable weather, which is concerning given how susceptible both pastures and cattle are to weather extremes in these rain-fed systems. Most ranchers perceived these changes as a threat to their livelihoods and, similar to other farmers, as reason to implement conservation-friendly practices (Ayanlade et al.

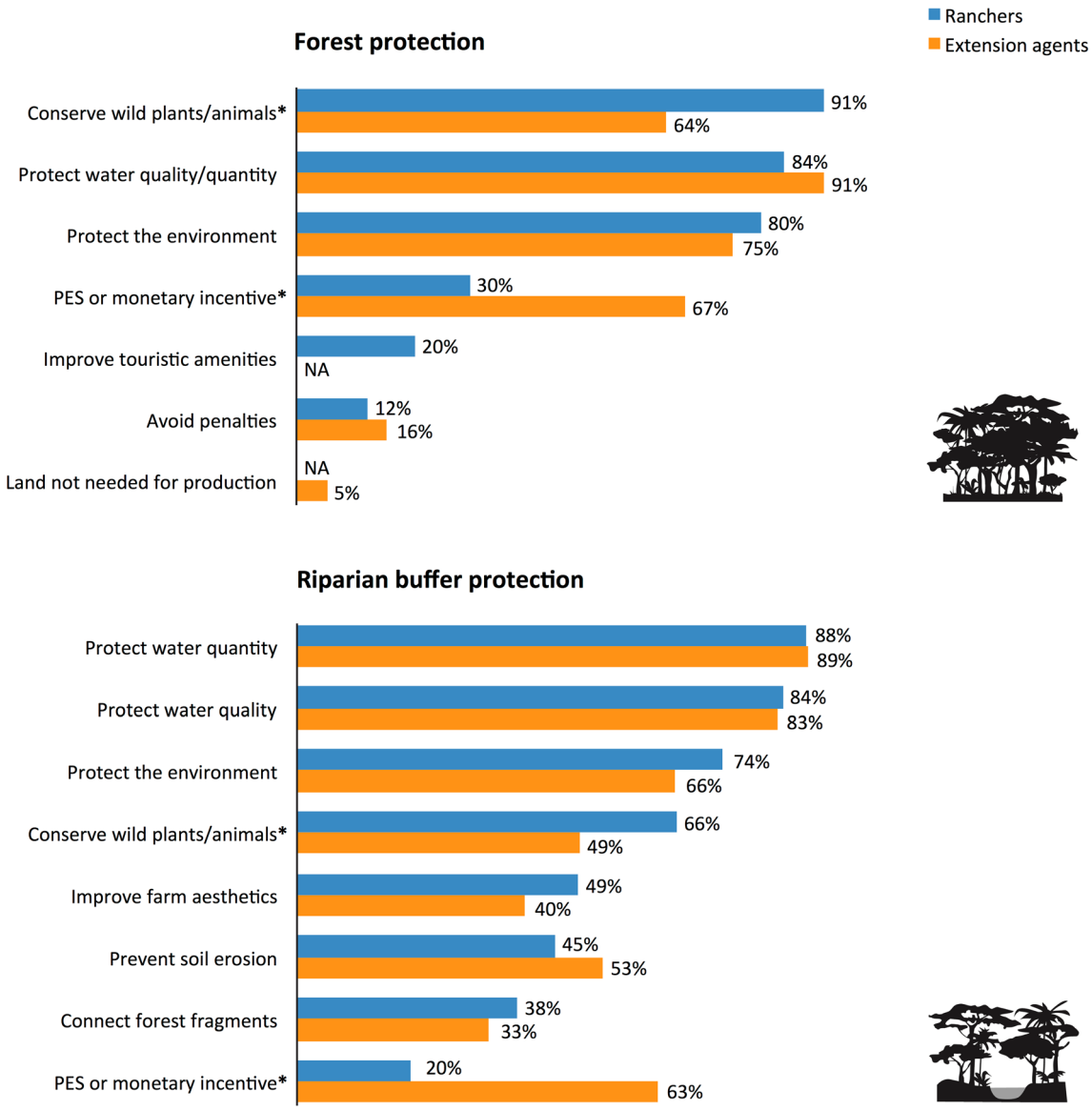

Fig. 2 Cattle ranchers' motivations for protecting or recovering forests (top) (n = 76 ranchers, 96 extension agents), and for protecting and recovering riparian buffers (bottom) (n = 74 ranchers, 96 extension agents). Items are listed from most to least important according to ranchers. Extension agents' responses reflect the estimated importance of the item among their group of ranchers. (*) Significant differences between ranchers and extension agents (X^2, $P < 0.05$); NA = Items were not available in one of the surveys

2017; Elum et al. 2017). Ranchers' most frequently cited motivations for adoption were often related to the need to address the threat of climate change, both its direct impacts (e.g., record high temperatures) and the human-induced problems that it can exacerbate (e.g., reduced water flows in deforested watersheds). The resulting sense of urgency has led many ranchers to take actions that directly protect their income, such as increasing pasture tree cover to reduce heat stress in the cattle. But it has also led ranchers to prioritize other interventions aimed at protecting key ecosystem services, such as reforesting riparian forests to regulate water flows in the face of extreme events. Similarly, Australian ranchers have adopted best management practices as a risk management strategy (Greiner et al. 2009). Previous studies have concluded that the use of external incentives, such as PES or regulation enforcement, is necessary to scale up adoption of practices that render more public than private benefits (e.g., forest protection) (Garbach et al. 2012; Latawiec et al. 2017). However, this study suggests that climate change could contribute to tip the balance in favor of conservation-oriented practices, which ranchers previously perceived as having little private value (Garbach et al. 2012; Pagiola and Rios 2013) but are increasingly proving critical for their successful adaptation. This shift in priorities creates an opportunity for practitioners to build more effective partnerships with cattle

Table 3 Changes in climate perceived by cattle ranchers, their impact on production, and the expected climate-related benefits of implementing conservation-friendly practices. Extension agents' responses reflect an estimate of ranchers who have specifically mentioned these changes. For (a) $n = 87$ ranchers, 98 extension agents; for (b) $n = 83$ ranchers, 90 extension agents for (c) $n = 82$ ranchers. Items in (c) are benefits free-listed by respondents under "other"

	Ranchers	Extension agents
a. Changes in weather noticed by ranchers		
Higher than normal temperatures	91%	95%
Increasingly unpredictable	81%	92%
More intense rainstorms	60%	55%
More severe dry season	57%	87%
Shorter than normal rainy season	49%	65%
Shorter than normal dry season	42%	15%
Longer than normal dry season	35%	61%
Longer than normal rainy season	33%	37%
Lower than normal temperatures	31%	17%
b. Impacts of climate change on productive activities		
Negative	70%	86%
Neutral	8%	3%
Positive	22%	11%
c. Benefits of conservation practices for facing climate change		
Climate regulation	Environmental/biodiversity protection	
Soil protection, erosion control	Better productivity and stability	
Water protection/regulation	Better animal welfare	
Direct benefits from trees	Better mitigation, adaptation, resiliency	
Protection from winds	Oxygen production	
Nitrogen fixation	Increased shade	

ranchers around the common goal of building resilient landscapes.

The practices adopted by MSCR ranchers reflect their interest in satisfying not only tangible utilitarian values (e.g., healthier cattle, increased soil fertility, receiving payments) but more intangible ones as well (e.g., healing the land, protecting the environment, aesthetic value). In particular, ranchers appreciated the conservation-friendly practices for their ability to satisfy their stewardship values—the sense of moral obligation to be good land custodians (Clearfield and Osgood 1986; Greiner et al. 2009)—, and their relational values—the sense of place and cultural identity rooted in interactions with nature (Hinds and Sparks 2008). Participation in conservation projects has been previously linked to the satisfaction of these and other intangible values (e.g., preserving a way of life, passing on land in good condition), which in turn can partially offset the expectation of economic compensation and still lead to enduring behavioral change (Farmer et al. 2011; Sorice et al. 2012; Greiner and Stanley 2013; Chan et al. 2016). This may explain why ranchers were willing to incur the risks and implementation costs of some conservation-focused practices even while knowing that they could only partially recover the costs (Greiner and Stanley 2013; Chan et al. 2017; DeMartino et al. 2017). FLR practitioners could therefore create new spaces for constructive dialogue with ranchers by explicitly communicating how conservation-friendly practices align with these other non-utilitarian values.

Coinciding with previous studies, respondents identified high input and maintenance costs and labor shortages (Calle et al. 2009; Garbach et al. 2012; Hayes 2012; Latawiec et al. 2017) as the main barriers preventing project participants from scaling-up conservation-friendly practices. The project supported initial small-scale trials on farms, covering some of the labor and materials cost. But even when trials yielded encouraging results, scaling-up to the entire farm was difficult as the support was often insufficient and many ranchers were not prepared to assume the additional labor, material, and opportunity costs needed to expand the new practices. For example, sourcing and transporting seedlings to remote locations or hiring labor for site preparation were challenging even for the more affluent participants. According to ranchers, many of these barriers could be removed if they received more in-kind support. Indeed, in-kind support can facilitate conservation by nudging individuals from intention to action, while fostering a sense of personal ownership for the project's outcomes (Kammin et al. 2009; Chan et al. 2017). Previous studies have also highlighted the importance of technical assistance for building trust, maintaining motivation and reducing the uncertainty associated with behavioral change (Wilcove and Lee 2004; Calle et al. 2009; Pagiola and Rios 2013; Swann 2016). However, ranchers in this project received ample technical assistance and capacity building, which may explain why they ranked these as lower priority incentives. Projects aiming to increase cattle rancher engagement should therefore use direct in-kind support to remove immediate implementation barriers and maintain high levels of technical assistance to ensure that resources are channeled toward specific conservation actions.

The most consistent discrepancy between ranchers and extension agents identified in this study was their perception about the importance of the PES incentive, which ranchers ranked much lower than extension agents as a motivation and a preferred incentive for adoption. Extension agents believed that cash payments were important, especially for the poorest ranchers, and that expanding this incentive could tip the balance in favor of conservation practices and potentially boost implementation, especially

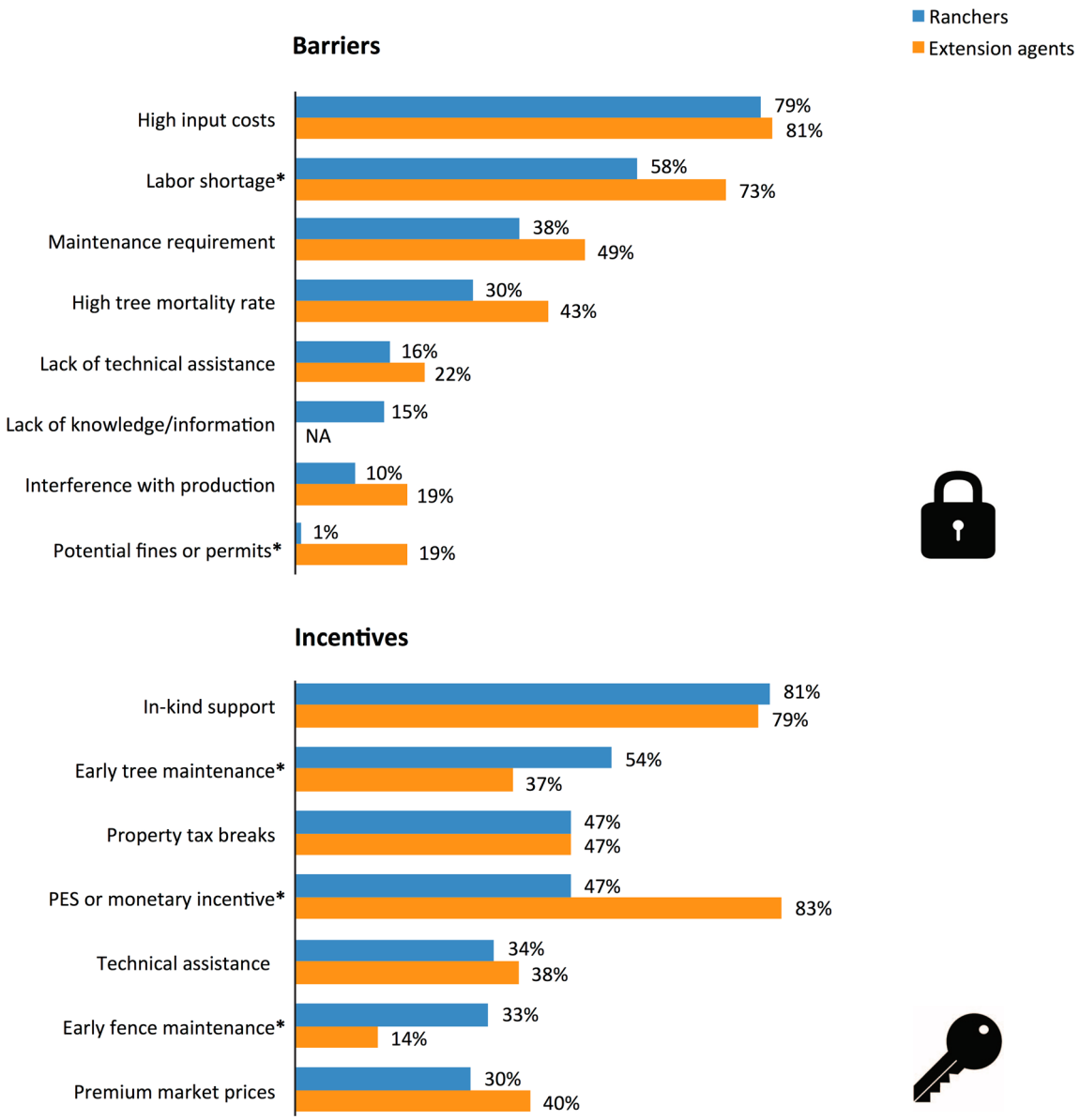

Fig. 3 Barriers preventing cattle ranchers from implementing more conservation-friendly practices (top) (n = 81 ranchers, 95 extension agents), and potential incentives to overcome these barriers (bottom) (n = 79 ranchers, 96 extension agents). Items are listed from most to least important according to ranchers. Extension agents' responses reflect an estimate of the importance of the item among their group of ranchers. (*) Significant differences between ranchers and extension agents (X^2, $P < 0.05$); NA = Items were not available in one of the surveys

when sustained long term. Empirical evidence supports this view, suggesting that permanent adoption of practices with high environmental benefits but low returns requires long-term PES (Garbach et al. 2012; Pagiola and Rios 2013). However, in some cases cash payments can also create dependency on monetary compensation (Falk and Fehr 2002; Vatn 2010) and generate false expectations that, if not met, can undermine trust and reduce participation rates (Stern and Coleman 2015). Cash payments also have high transaction costs and therefore limited large-scale applicability, especially in the long term (Pattanayak et al. 2010; Vatn 2010). During interviews, many ranchers admitted that while the prospect of cash payments initially enticed them to sign up for an unfamiliar project, their enthusiasm for this incentive tapered off rapidly because payments were delayed, lower than expected, or reached a cap. Despite these problems with direct PES, ranchers' interest and participation in the project remained strong, possibly as they experienced other co-benefits and their motivations for engaging in conservation-friendly practices shifted. This may explain why, when asked about scaling-up conservation practices in the future, ranchers leaned toward the more reliable in-kind support and away from the less certain monetary compensation. Nevertheless, extension

agents make an important point when they argue that cash incentives, even small ones, can send a powerful message about the value that society assigns to sound stewardship (Kosoy et al. 2007; Chan et al. 2017). If so, cash payments could be more meaningful as recognition to ranchers' ongoing dedication than as an incentive to catalyze action. Ultimately, designing flexible mixed-incentive models that combine in-kind support with small monetary rewards could be critical to enable and maintain ranchers' commitment to conservation practices.

CONCLUSIONS

Cattle ranchers will shape the future of vast managed landscapes in Latin America and elsewhere, and their participation is essential if large-scale FLR projects are to succeed. As conservation organizations recognize the need to engage more effectively with ranchers, replacing assumptions about their beliefs with a more nuanced understanding of their actual perceptions and behaviors regarding production, conservation, and their role as environmental stewards is critical. This study reflects on the perspectives of Colombian cattle ranchers as they transition to conservation-friendly practices, but its conclusions may be applicable to a growing number of ranchers globally who are turning to silvopastoral systems and other sustainable management practices in response to similar patterns of declining production and concerns over climate change. These results suggest that coupling sustainable production with conservation practices can appeal to a broader range of motivations and values, thereby increasing participation and reinforcing long-term behavioral change. Furthermore, climate change is emerging as a strong motivator for the adoption of conservation-friendly practices and should be explicitly leveraged as a common goal for collaborations between ranchers, FLR practitioners, conservation organizations, and funders. Flexible hybrid incentive schemes combining in-kind support for immediate implementation with smaller monetary incentives that recognize good stewardship could effectively help ranchers overcome existing barriers and deliver lasting conservation outcomes.

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