Psycho-social factors influencing forest conservation intentions on the agricultural frontier

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Abstract

Remnant forest fragments are critical to conserve biological diversity yet these are lost rapidly in areas under agricultural expansion. Conservation planning and policy require a deeper understanding of the psycho-social factors influencing landholders' intentions towards conserving forest fragments. We surveyed 89 landholders in an agricultural frontier of the South American Gran Chaco and employed survey data to test three social psychological models: the Theory of Planned Behavior (TPB) and two modified versions of it, one integrated to the Norm Activation Theory (TPB-NAT) and one including the effect of identity (TPB-NAT-Identity). The TPB was the most parsimonious model and explained a large variance of conservation intentions (41%). Social norms and attitudes had the largest direct influence on intentions across the three models, and identity had a significant role in shaping social norms and attitudes. Interventions aimed at building social capital within landholder networks provide the best hope for influencing pro-conservation norms.

Introduction

One of the major global drivers of biodiversity loss is the expansion and intensification of agriculture into tropical and subtropical ecosystems in developing countries to supply the increasing demand for food, fibres, and biofuels from developed and emerging countries (Lambin & Meyfroidt 2011). In areas under agricultural expansion (i.e., agricultural frontiers), landholders decide on the fate of remnant native forests influenced by external or "structural" factors (e.g., land tenure regimes, market forces) and internal or "human agency" factors (e.g., education level, social norms) (Roy Chowdhury & Turner 2006). Considerable evidence exists on the effects

of structural factors on agriculture-driven deforestation (e.g., Angelsen & Kaimowitz 2001), but little is known about the role of human agency in determining the configuration of landscapes (St John *et al*. 2010; Meyfroidt 2012), despite its importance being widely acknowledged (Lambin 2005). Resources for conservation in developing countries are very limited and therefore a better understanding of the human and social processes underlying forest loss is needed to prioritize conservation actions.

The social psychological theory most often used to explain conservation behavior is the Theory of Planned Behavior (TPB, Ajzen 1991). According to the TPB, behavior is mainly motivated by self-interest and its most proximal predictor is behavioral intentions. In turn,

behavioral intentions are influenced by attitudes (i.e., tendency to value the behavior favorably or unfavorably), social norms (i.e., perceived pressure from relevant others to perform the behavior), and perceived behavioral control (i.e., the extent to which the behavior is perceived to be under volitional control). The few TPB applications in rural environments have focused on farmers' adoption of practices to conserve soils (Lynne *et al.* 1995; Wauters *et al.* 2010) and vegetation on field margins (Beedel & Rehman 1999; Fielding *et al.* 2005). Applications of TPB should be expanded to explain behaviors that have the greatest effect on biodiversity and that have the potential to change conservation-oriented outcomes (Gardner & Stern 2002). Hence, we apply the TPB to explain the intention of rural landholders to conserve remnants of dry Chaco forests in Northern Argentina threatened by agricultural expansion.

The TPB has been adapted to increase its explanatory power in particular contexts (Ajzen 2011). For example, Bamberg & Moser (2007) have integrated the TPB with the Norm Activation Theory (NAT, Schwartz 1977), which posits that behavior is pro-socially motivated with its main predictor being personal norm, characterized by feelings of personal obligation to perform the behavior. In the context of conservation behavior, knowledge about environmental problems and awareness of their consequences are probably important cognitive preconditions for triggering personal norms (Bamberg & Moser 2007), and social norms are thought to underlie the activation of personal norms (Bamberg *et al.* 2007). Therefore, we add personal norms as a proximate predictor of intention, as well as problem awareness (i.e., the knowledge on the scale and severity of a problem) and awareness of consequences (i.e., the perception that an action has negative consequences for others) as underlying factors of the constructs in the TPB, to test a model integrating both self-interest and pro-social motives (i.e., TPB-NAT model).

For conservation behavior in agricultural systems, Burton & Wilson (2006) propose that identity (i.e., the behaviors that are perceived as part of the self) is a significant factor underlying land-use decision-making. These authors support that identities are multiple and hierarchical (Stryker 1994) and that occupational identities of farmers (e.g., agribusiness person) are the most salient in the hierarchy; this stimulates the adoption of roles and behaviors for which the individual and the group share expectations, such as clearing native vegetation to farm intensively. Past behavior has been suggested to better measure perceived behavioral control in the context of agriculture (Wauters *et al.* 2010). Therefore, we also add identity and past behavior to the integrated TPB-NAT model in order to test a model tailored to the characteristics of agricultural agency (i.e., TPB-NAT-Identity model).

In predicting our target intention, we will make a methodological and theoretical contribution through the use of an information-theoretic approach to directly compare three models: the standard TPB model and two modified versions of it, one adapted to behaviors related to the environment (TPB-NAT model) and one tailored for decisions in the context of agriculture (TPB-NAT-Identity model). Considering that interventions will vary greatly depending on the factors driving landholders' decisions, the identification of the main social psychological drivers will allow for interventions in the Gran Chaco to be more efficiently designed and targeted.

Methods

The study area covers ca. 10,000 km^2 in the Chaco province, in the Northwest of Argentina, and corresponds to the eastern portion of The Chaco Impenetrable, one of the largest remnant tracts of Neotropical dry forests, a globally threatened biome. Government-led colonization programs in the mid 20th century promoted extensive cattle ranching and increased human pressure on this fragile environment, but the magnitude and pace of forest degradation and loss increased exponentially with the arrival of soybean farmers and intensive cattle ranchers from the 1990s (Altrichter & Basurto 2008). In the Chaco province, the deforestation frontier advances today from the subhumid margins (900–1,100 mm of annual rainfall) to the semiarid core (<900 mm), forming an arc from the towns of Miraflores and Juan José Castelli in the northeast, and Concepción del Bermejo and Pampa del Infierno in the southwest of the study area (Figure 1). In a neighboring province (Salta), agricultural expansion drove the loss of native forests at annual rates of 1.5–2% from 2005 to 2010 (Seghezzo *et al.* 2011), also leading to the violent displacement of peasant and indigenous people. In response, the Argentine government passed a Forest Law in 2008 to regulate the use of forest lands by establishing zones for agricultural production, sustainable use, and nature conservation. A previous study suggests that reconciling production and conservation in the ecologically fragile Gran Chaco requires landholders to integrate forest fragments and strips into their food production systems (Mastrangelo & Gavin 2012).

Survey and questionnaire design

We review the literature on land use history of the study area and divide it into four subareas (named after the largest town) from those with older and more extensive deforestation to those with more recent and localized deforestation: Juan José Castelli, Miraflores, Concepción del Bermejo, Pampa del Infierno. Then, we
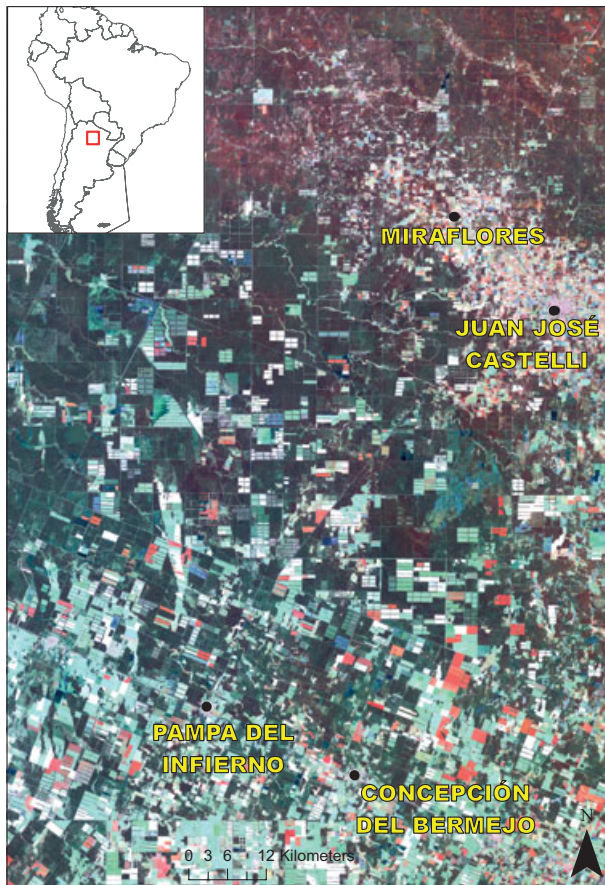
Figure 1 Satellite image (Landsat TM) of the study area in the Argentine Chaco, showing the distribution of cleared areas (lighter rectangular areas) and of remnant native dry forests (darker irregular areas). Forest clearing for soybean and pasture expansion advances from east (subhumid, more fragmented) to west (semiarid, less fragmented) and into the core of the Chaco Impenetrable, one of the largest remnant tracts of Neotropical dry forests. Inset: location of the study area (red square) in South America.

classified landholdings on the basis of analysis of satellite images and cadastral maps according to three characteristics: (i) subarea, (ii) size (small: 1–200, medium: 201–2,000, and large: >2,000 ha), and (iii) land tenure condition (landholdings with complete, incomplete, or no cadastral information). Above 80% landholdings in each subarea corresponded to medium-sized landholdings with complete cadastral information. We randomly selected 25 landholdings within the most frequent size and tenure classes in each subarea, of which 11 refused to participate, leading to a final sample of 89 landholdings.

We surveyed landholders in July 2012 using a questionnaire approved by the Human Ethics Committee of Victoria University of Wellington (#19477). Prior to the survey, we collected 33 semi-structured interviews from selected landholders to elicit salient beliefs, perceptions, and/or values that may influence intentions to conserve forest fragments in their landholdings. From the qualitative analysis of interview content, we selected three salient beliefs, perceptions, and/or values related to each of the nine theoretical constructs (Table S1). We then designed a list of 27 questionnaire items following the principle of compatibility (Ajzen 2011), where the target of the action was forest fragments, the action was their conservation (i.e., no clearing, no intensive timber extraction), the context was the landholding of the respondent, and the time was July 2012–July 2013 (Table S2). One interviewer (MEM) visited each landholder, to whom he asked questionnaire items in the same order and with the same wording.

In the iterative process of item generation and selection, we sought a balance between developing items that were redundant enough to achieve sufficient internal consistency of constructs and items that were dissimilar enough to capture the salient dimensions of each construct (Graham *et al.* 2011). We piloted the questionnaire with eight landholders to ensure that statements and scales were clear and relevant. We also employed the questionnaire to collect social (e.g., participation in forums and networks), economic (e.g., access to external fund), and demographic (e.g., age of the landholder) information of landholdings (Tables S3 and S4).

Structural equation modeling allows testing the validity of the measurement (i.e., relating measured items and theoretical constructs) and structural models (i.e., relating theoretical constructs) in a single step, but requires large sample sizes to test complex models (Byrne 2001). We employed a two-step approach as it reduces the demand for large sample sizes and allows testing complex models in contexts where data collection is very time-consuming, like in our study area. First, we tested construct validity by calculating the contribution of measured items to the corresponding construct using confirmatory factor analysis in AMOS 19 (IBM, Chicago, IL, USA) (Schumaker & Lomax 2004). Second, we tested the relationships among constructs using the maximum-likelihood procedure on validated construct scores comprising weighted averages of confirmed measured items in AMOS 19. We employed an information-theoretic approach with the Akaike information criterion (AIC) to compare the degree of fit and parsimony of the three social psychological models (Burnham & Anderson 2002).

Results

The majority of landholdings were family enterprises (96.6%), and interviewed landholders were all male,

most born in the Chaco region (92%) and residing in the landholding (53%) or in the town nearest to the landholding (44%, Table S3). Landholders' age (range: 25–75 years), farming experience, time of tenure of the landholding (range: 2–64 years), level of formal education, and participation in forums and networks ranged widely (Table S4). Landholdings were located in zones under two conservation categories according to the provincial land-use plan, with 64% on category I (total forest clearing permitted) and 34% on category II (only selective clearing permitted). Most landholders reported no intention to either lease (64%) or sell (81%) all or part of their landholdings in the near future. Landholding size ranged from 180 to 1,764 ha. An average landholding had 300 ha, of which 60% was covered by forests (usually used by cattle), 15% by cropland (cereals in winter, soybeans in summer), and 25% by pastures (15% as silvopastoral systems). None of these attributes had a statistically significant correlation with landholders' intentions to conserve forest fragments in their landholdings ($P > 0.05$).

Most landholders (77.5%) reported a positive intention towards conserving forest fragments in their landholdings, which was statistically correlated with the perception of the self as a steward of the land ($r = 0.415$, $P < 0.001$). Landholders' perception of forest clearing as an environmental problem were higher than the scale mid-point (mean score = 3.59, $t = 5.95$, $P < 0.01$, Table S1), with stronger perceptions reported by those with less secure conditions of land tenure ($r = -0.239$, $P < 0.05$), lower access to external funding ($r = -0.230$, $P < 0.05$), and lower labor to consumer ratio ($r = -0.245$, $P < 0.05$). Landholders' level of awareness of the negative consequences of forest clearing on native fauna, soils, and local climate were high on average (mean scores > 3.6, all $P < 0.01$). A higher awareness of the effects on soils was reported by landholders located in subareas with more extensive and longer history of deforestation ($r = 0.322$, $P < 0.001$) and of the effects on local climate by younger landholders ($r = -0.244$, $P < 0.05$).

Landholders' feeling of obligation to conserve forests because of their intrinsic value was higher than neutral (mean scores > 3.66, $t = 4.23$, $P < 0.01$), with stronger feelings reported in landholdings with smaller crop, pasture, and total area ($r = -0.237$, $P < 0.05$) and higher family labor ($r = 0.305$, $P < 0.01$). Landholders' valuation of the aesthetic value of forests was higher than neutral (mean scores > 3.96, $t = 9.23$, $P < 0.01$), with higher values reported by landholders with more years in farming ($r = 0.219$, $P < 0.05$), smaller crop area ($r = -0.341$, $P = 0.001$), and larger silvopastoral area ($r = -0.277$, $P < 0.01$). Finally, a lighter degree of forest transformation in the landholding from 2009 to 2011 was reported by landholders that participated in a larger number of fo-
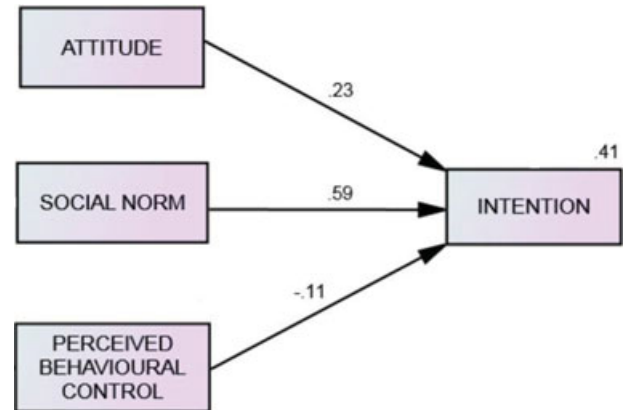

Figure 2 Graphical output of the TPB model showing a large effect of social norms ($\beta = 0.59$), a relatively moderate effect of attitudes on intentions ($\beta = 0.23$), and a small effect of perceived behavioral control ($\beta = -0.11$) on intentions. Numbers in the upper right-hand corner of boxes for constructs are coefficients of determination (R^2) and numbers on arrows are standardized regression coefficients (β).

rums and networks ($r = -0.215$, $P < 0.05$) and with less secure tenure of land ($r = -0.244$, $P < 0.05$).

Measurement and structural models

The 25 regression coefficients between measured items and their corresponding constructs (i.e., factor loadings) were mostly moderate to high (Table S1). Three measured items with factor loadings below 0.25 were not included in the analyses. Cronbach's alpha coefficients were higher than 0.65 for all constructs, which is acceptable in human dimensions research (Vaske 2008). Mean correlation between constructs was low (0.186 [SD = 0.29]), indicating that they were measuring different aspects of landholders' cognitions. The TPB model showed moderate fit to survey data ($\chi^2/\mathrm{df} < 5$, standardized root mean residual (SRMR) ≈ 0.1, root mean square error of approximation (RMSEA) > 0.2) but explained 41% of the variance of landholders' intention to conserve forest fragments in their landholding (Table 1). Social norms had the largest effect on intentions ($\beta = 0.59$), followed by attitude ($\beta = 0.23$), and a small negative effect of perceived behavioral control ($\beta = -0.11$) (Figure 2). In contrast, the TPB-NAT model (Figure 3) had a better fit to survey data ($\chi^2/\mathrm{df} \approx 3$, SRMR ≈ 1, RMSEA < 0.2), but explained less of the variance (31%) compared to the TPB. The TPB-NAT-Identity model (Figure 4) had a good fit to survey data ($\chi^2/\mathrm{df} < 2$, SRMR ≈ 0.1, RMSEA ≈ 0.1) and explained as much variance of intention as the TPB (42%). Despite its fit, the TPB can be regarded as the best model because: (i) the difference in the AIC with the second best model (TPB-NAT-Identity)

Table 1 Model fit indices of the three psycho-social models employed to explain landholders' intentions towards forest conservation. Where: SRMR = standardized root mean residual; GFI = goodness of fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; AIC = Akaike information criterion

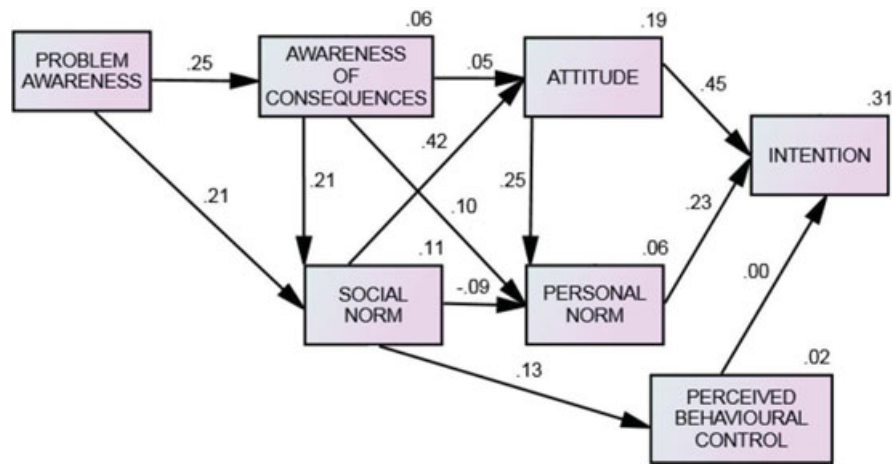| Model	Model fit indices									
	χ^2	df	χ^2/df	SRMR	GFI	CFI	RMSEA	AIC	ΔAIC	R^2
TPB	18.77	4 ($P = 0.001$)	4.69	0.17	0.89	0.65	0.23	30.71		0.41
TPB-NAT	28.41	9 ($P = 0.001$)	3.15	0.99	0.9	0.69	0.17	66.41	35.7	0.31
TPB-NAT-Identity	26.54	16 ($P = 0.47$)	1.65	0.11	0.91	0.87	0.09	66.54	35.8	0.42

Figure 3 Graphical output of the TPB-NAT model showing that the addition of personal norm as a proximate predictor and problem awareness and awareness of consequences as underlying predictors did not increase the amount of explained variance in intention as compared to the TPB model. To the contrary, explained variance of this model was 10% lower than the TPB due to a more indirect influence of social norms on intentions. Numbers in the upper right-hand corner of boxes for constructs are coefficients of determination (R^2) and numbers on arrows are standardized regression coefficients (β).

was much larger than 2 (AIC = 35.7, Table 1), the threshold usually used to identify a substantially better model on the basis of its fit and parsimony (Burnham & Anderson 2002), and (ii) it explained a large amount of the variance in behavioral intention.

Discussion

We integrated components of basic social psychological theories oriented to explain behavior driven by self-interest and pro-social motives to build candidate models *a priori* more or less tailored to explain conservation behavior in the context of agriculture. Other social psychological theories such as the Value-Belief-Norm Theory (Stern *et al.* 1999) derive from these basic theories and seek to explain general conservation behaviors, and thus were not employed here. Previous research have mostly relied on socio-economic attributes to explain land use behavior (e.g., Roy Chowdhury & Turner 2006), but our findings showed that none of the landholder attributes surveyed was associated with their conservation intentions. Instead, landholders' intention towards remnant habitats was influenced by psycho-social factors.

The information-theoretic approach is particularly useful in environmental psychology where it allows for a direct comparison of the many different constructs and models that have been proposed to influence a variety of behaviors. To our knowledge, this is the first use of this approach to examine the drivers of land use intentions. Our findings indicate that TPB had the highest degree of fit and parsimony. The variance of intention explained here by the TPB (41%) was higher than the explained variance found (27%) in a meta-analysis of 185 independent TPB studies (Armitage & Conner 2001). The model more tailored to explain conservation behavior in agriculture (TPB-NAT-Identity) explained a similar amount of variance than the TPB (42%). This means that in this context TPB is able to explain a similar proportion of the variance usually explained by social psychological models in other behavioral domains, providing a simple and
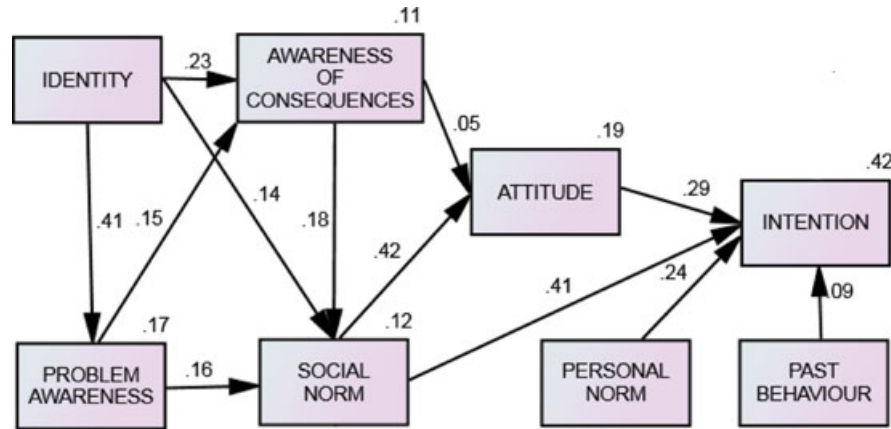
Figure 4 Graphical output of the TPB-NAT-Identity model showing that social norms had the largest overall effect on intention both due to a direct effect ($\beta = 0.41$) and an indirect effect mediated by attitudes ($\beta = 0.54$). Identity had a large effect on intention, via its effects on social norms ($\beta = 0.14$), problem awareness ($\beta = 0.41$), and awareness of consequences ($\beta = 0.23$). Numbers in the upper right-hand corner of boxes for constructs are coefficients of determination (R^2) and numbers on arrows are standardized regression coefficients (β).

comprehensive framework for identifying key variables relevant for the design of conservation interventions (St John *et al.* 2010).

Social norms had the most prominent influence on intention in both the TPB ($\beta = 0.59$) and TPB-NAT-Identity ($\beta = 0.41$) models, reinforcing the notion that farmers constitute a judgemental peer group (de Snoo *et al.* 2012). Attitude had an important role as driver of intention across the three models ($\beta = 0.23$–0.45), similar to studies using TPB to explain the choice of agricultural (Fielding *et al.* 2005; Wauters *et al.* 2010) and silvicultural practices (Karppinen 2005). Perceived behavioral control did not influence conservation intentions, suggesting the absence of factors inhibiting the behavior (Wauters *et al.* 2010). The positive effect of past behavior supports the notion that perceived difficulty rather than perceived control influences conservation intentions in agriculture (Primmer & Karppinen 2011). Contrary to Wall *et al.* (2007), the integration of the TPB and NAT models did not increase the explanatory power, due in part to weak effect of social norms on personal norms. Identity had a significant underlying influence on conservation intentions through a positive effect on awareness of the problem and of the consequences of landholders' behavior. These results suggest that social norms and identity are important determinants of intentions to conserve habitats in productive lands, in line with Primmer & Karpinnen (2010) and Lokhorst *et al.* (2011).

Most landholders in our sample hold positive intentions towards conserving forest fragments in the near future. However, a significant proportion of them (22.5%) reported a weak conservation intention, which means that they probably plan to clear forest fragments in

their landholding. Encouraging this significant proportion of landholders to alter their behavior towards more conservation-oriented outcomes requires informed behavior change interventions. Our findings suggest that (re)establishing social norms that reward conservation behaviors within groups of landholders to which they identify with may be critical to achieve long-term conservation of dry Chaco forests.

Social norms are shared understandings and expectations among group members on how to behave when faced with individual choices relevant to the group (Ostrom 2000). In general, behavior of land users can be influenced by: (i) providing economic incentives, (ii) enforcing government legislations, or (iii) building social capital (de Snoo *et al.* 2012). Economic incentives based on market mechanisms or government contracts in the Argentine Chaco will seldom drive lasting changes in conservation behavior because of their temporary and volatile nature. Moreover, economic incentives can erode social norms by turning behaviors motivated by social norms into behaviors financially motivated (de Snoo *et al.* 2012). Government legislations can lead to the internalization of pro-conservation norms and rules if accepted by the majority of landholders and implemented for a long term (Stobbelaar *et al.* 2009). However, land use plans in the Argentine Chaco are ignored or perceived as illegitimate by most landholders because of their passive participation (if any) in the planning process (Seghezzo *et al.* 2011), reducing the chance for existing regulations to exert long-lasting normative influences.

To be effective, interventions aimed at influencing social capital should be implemented based on an in-depth knowledge of the context and dynamic of existing social

groups and networks (Minato *et al.* 2010). In the Argentine Chaco, two broad types of social networks or participatory processes exist (Garcia-Lopez & Arispe 2010). On the one hand, commercial producers operating over large landholdings participate in networks initiated by multinational corporations and international NGOs (top-down process), where they learn about new technological inputs and compare outcomes against peers. In this case, individuals and organizations in Argentina and importing countries concerned about deforestation in the Chaco should demand better environmental performance of large commercial landholders to foster higher environmental benchmarks within their peer networks (de Snoo *et al.* 2010). On the other hand, peasant smallholders participate in self-organized networks (bottom-up process) that work towards securing land tenure and food sovereignty. Local non-governmental organizations and government extension agencies working with peasant smallholders should promote existing knowledge and norms, which are intrinsically compatible with forest conservation, and grant land property rights so they can exert safe stewardship on their lands.

Acknowledgments

Supporting Information

Additional Supporting information may be found in the online version of this article at the publisher's web site:

Table S1: Factor loadings (i.e., correlations between item and construct scores) and summary statistics for item scores and *t*-value for the comparison of mean score versus scale mid-point.
Table S2: Statements and scales of each item of the questionnaire.
Table S3: Frequencies for qualitative attributes of surveyed landholdings.
Table S4: Summary statistics for quantitative attributes of surveyed landholdings.

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