



## Synthesis

# From Scientific Speculation to Effective Adaptive Management: A case study of the role of social marketing in promoting novel restoration strategies for degraded dry lands

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**ABSTRACT.** This article focuses on the role of social marketing, in particular the analysis of the motivations and capabilities of stakeholder groups, in encouraging acceptance of an innovative experimental approach to semiarid shrub land restoration in Chile. Controlled scientific experiments involving herbivory control during El Niño events have proved promising, but have not yet been introduced into ecosystem management approaches. Social marketing, as a lens for focusing on and understanding stakeholders' motivations, provides a valuable framework in which strategies may be developed for diffusing promising scientific experiments into regional management contexts.

**Key Words:** *adaptive management; climate fluctuations; dryland restoration; ecosystem restoration; ENSO; herbivory control; matorral; Mediterranean shrub land; reforestation; social entrepreneur; social marketing; stakeholder.*

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## INTRODUCTION

Despite a growing body of literature on the importance of scientific experimentation for policy makers and managers (Biggs and Carpenter 2009), there is little systematic exploration of the process of moving from successful scientific experimentation to effective management practice, whether through the establishment of social policy, grass-roots mobilization or stakeholder engagement. This is due, in part, to the sheer complexity of the problem: an understanding of the entire system is necessary to produce widespread transformation (e.g., population reduction through family planning policies and simultaneous regulation that avoids unintended or dysfunctional consequences, such as female infanticide [Ness and Ando 1984]). "Marketing" social innovations also produces challenges. Many attempts to scale up new ideas for greater impact assume a supply-demand relationship (Mulgan 2006). However, this relationship may not exist if the product or idea is too new to have generated a demand, too complex to be understood by those who might benefit, or too disruptive to gain the support of powerful individuals in society. Some approaches employ a diffusion of innovations

technique (Rogers 1995, Cooperrider and Dutton 1999), a process that is time-consuming and focuses not on stakeholder groups but rather on consumers' relationship to novelty (early adopters vs. late adopters). The rapid movement of new scientific ideas or experiments can be challenging when that goal requires the cooperation of a multitude of heterogeneous social actor groups who are not scientists and who may not immediately recognize the positive benefits of new practices.

In this paper, we use the problem of how to market a novel approach to the restoration of the degraded drylands in central Chile as a case study to explore the more general challenge of moving from a scientific idea to its general acceptance and use in practical land management.

About 40% of the drylands worldwide face signs of vegetation loss and degradation (Millennium Ecosystem Assessment 2005), and this is only expected to increase under future climate change scenarios (Intergovernmental Panel on Climate Change 2007). In many of these ecosystems, human intervention is necessary to stimulate the recovery of perennial vegetation. The fact that reforestation

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projects often have limited success makes it a priority to assess the socio-ecological barriers to successful ecological restoration.

The focus of this discussion is Chile's fragile, semiarid central region where the country's human population is most concentrated and where, consequently, land uses have radically changed the original landscape. In ancient times, extensive shrub and tree stands probably covered large parts of this region, but since the arrival of the first colonists in 1570, mining, deforestation, agriculture and overgrazing have reduced native vegetation and replaced it with urban sprawl, plantations, exotic species and degraded land (e.g., Fuentes and Muñoz 1995, Armesto et al. 2009). As late as 1962, there were descriptions of native forested areas in the valleys of central Chile. Since then, even these patches of dry forests and evergreen shrub lands have been taken over by large-scale agricultural production (Altieri and Rojas 1999) and by spreading urbanization. Chile's environmental protection has suffered from the alternation and instability of political regimes, which has left the environmental ministry responsible for conserving the native forests (CONAF) with relatively little clout compared to the industrial, resource extraction, timber and even agricultural interests. Therefore, although legislation is in place concerning native forests, the relatively low perceived economic value of the original evergreen shrub lands and forests (matorral), combined with the flexibility built into the legislation, means that there is very little real protection for native species (Diez 1996, Silva 1997). Today, most of the non-cultivated areas of this long central valley are dominated by a human-made *Acacia cavens* savanna (Fuentes et al. 1989). Only the foothills of the Andes and small pockets of the Coastal Range preserve remnants of the matorral, albeit mostly in a disturbed patchy state (Fuentes et al. 1984, 1986, Holmgren 2002, Armesto et al. 2009).

Restoration of degraded drylands has proved challenging. In the remaining matorral, the combined effect of drought and grazing makes the establishment of new trees, crucial for the restoration of the original semiarid shrub lands and dry forests, extremely difficult (Fuentes et al. 1984, 1986, Holmgren et al. 2000). Both of these constraints are often so serious that the amelioration of only one of them is not enough. Therefore, ecologists have advanced the theory that while removing herbivores does not help the vegetation

to recover during normal years, removing vegetation during a wet year may tip the balance enough to allow recovery (Holmgren and Scheffer 2001).

In 2001, a group of ecologists set out to discover if the rainy periods associated with ENSO events (El Niño Southern Oscillation) might be used in combination with grazer control to facilitate tree establishment in the drylands of both central/northern Chile and northern Peru. Rainy ENSO years are a valuable resource because they can be forecasted months in advance, their predictability is increasing, and rainy ENSO episodes have triggered structural and long lasting changes in other arid and semi-arid ecosystems in the past (Holmgren et al. 2001, 2006b). Examples include regeneration of woodlands in semiarid Australia (Austin and Williams 1988) and Peru (PREMIA 1992, Quispe-Cáceres 2002, Vilela-Pingo 2002, Albán et al. 2003, Bravo-Ferro and Rodríguez-Sánchez 2003), as well as large increases in shrub cover in the Chihuahuan desert, which straddles the US-Mexican border (Brown et al. 1997).

In Chile, small-scale controlled field experiments demonstrated that tree seedling establishment was undermined by herbivores and that protection, particularly against rabbits and hares, was essential to successful establishment (Holmgren et al. 2006a, Gutierrez et al. 2007, Squeo et al. 2007). Thus, to expand these experiments into a full restoration project would have required the collaboration of the individuals and groups who owned or controlled the patches of matorral, using them for agricultural, urban development or resource extraction purposes. These "stakeholder" groups, including governmental organizations, private landowners, farmers and natural resource industries (particularly mining) would eventually have to be convinced to work with scientists, on short notice, to establish restoration projects. At one level, successful restoration would require the collaboration of a variety of government departments (see Table 1). At another level, it would require the collaboration of the remaining stakeholders. While the scientists working in the National Parks participated in the initial experiments in the interests of science, what would motivate other stakeholder groups to undertake long-term collaboration? Would the soundness of the experiment alone be enough? Insights drawn from the field of social marketing suggest otherwise.

**Table 1.** Stages in El Niño experiment.

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Field observations and studies	correlate rainy El Niño events with increased plant production.
Small experiments	demonstrate that herbivores preclude tree establishment even under simulated El Niño rainy conditions.
Medium-sized experiments during natural El Niño events	are needed to test underevaluate?/demonstrate? which environmental settings using herbivore control during rainy years result in produce significant tree/shrub recruitment. Creation of a network of field cases set up by local stakeholders.
Policy making	coordinate action between institutions to set up a management plan that encourages the use of herbivore control during rainy El Niño years for reforestation, (e.g. Comisión Nacional del Medio Ambiente (CONAMA), Ministry of Agriculture, Institute of Metereology, Corporación Nacional Forestal (CONAF), Non-governmental Organizations (NGOs), United Nations Convention to Combat Desertification (UNCCD) as national focal point).

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## **SOCIAL MARKETING: AN APPROACH TO SUPPORTING CONSERVATION**

Marketing has become a sophisticated management science, vital to private sector organizations intent on selling products or services in the marketplace. Market research is based on the premise that a heightened understanding of the lifestyles, needs and motivations of the distinctive market "segments" that the producer wishes to exploit will allow the producer to get the right "market mix" of product, price, place, promotion and people to sell the product. Understanding the perceptions held by the target consumers about the product, the value they place on the product (and the price they would be willing to pay for it) and where and by whom it is best delivered help to inform advertising and promotion campaigns.

In 1989, Kotler introduced the idea that not all transactions in the market are cash transactions for concrete products. Ideas are also "sold," Kotler argued, and certain ideas are of enough value to society to be "marketed" irrespective of individual consumer demand (Kotler and Roberto 1989). This perspective gave rise to the field of "social marketing."

While there has been some discussion in the conservation literature about the use of social marketing in "selling" scientific environmental knowledge to concerned stakeholders (Chapin and Whiteman 1998, Whiteman 1999, Bromley 2002, Brechin et al 2002), in general, the emphasis has

been on promotion strategies and communicating value to different groups through clear and appealing messages. As in other areas of social marketing (for example, health care), there has been a tendency to forget that marketing is fundamentally about exchange, or as Kotler put it, "encouraging voluntary behavior of the target audience by offering benefits they want, reducing barriers they are concerned about and by using persuasion to motivate their participation in program activity" (Kotler and Roberto 1989:24). An exception is Rothschild (1999), whose excellent analysis pointed out that in the social marketing of health care, the notion of exchange is more problematic than in classic commercial exchanges because a) there is often not a clear correlation between the changed behavior and self interest (e.g., people may actually find it more rewarding to eat rich food than to diet, despite the health consequences) and b) the time lag between exchange and payback may be much longer (health does not improve after the first day of eating healthy food). This, Rothschild argues, should make researchers more--not less--aware of the intricacies of exchange, as persuasion alone may be of limited value.

Whether a stakeholder group is prone, reluctant or unable to support a social initiative, such as conservation, will depend on three things: the group's motivation to act, its ability to act (in terms of having the appropriate skills) and its opportunity to act (in terms of whether or not the external conditions support action). In the domain of conservation studies, three different motivations

seem to lie behind corporate inclinations to protect the natural environment (Vredenburg and Westley 2002). They may be motivated by regulation: if the corporation fails to engage in conservation, they will suffer penalties. They may be motivated by the market: if they engage in conservation activities, there will be some tangible short- or long-term economic benefit. Alternatively, they may be motivated by non-economic values: they engage in conservation because they value the ecosystem for scientific, traditional, aesthetic or spiritual reasons. Of course, individuals or groups may be motivated by a combination of these factors.

Opportunity and ability are also important. Opportunity points to availability of external resources. For example, one might be motivated to recycle but be prevented by the absence of such a program in the community. Ability is also important and may inhibit or facilitate a response if the skills to respond are not possessed by the individual or organization motivated to do so. Obviously, when skill, opportunity and motivation coincide, very little education, marketing or coercion is needed. In the complex world of conservation, however, this is seldom the case. Conservation scientists interested in moving their projects beyond the laboratory and into a broader social context need to be aware of the role of all three of these qualities in groups with whom they seek to interact (Rothschild 1999).

## METHODOLOGY

With Rothschild's framework in mind, the authors of this study conducted exploratory interviews to provide the scientists interested in El Niño restoration experiments with some insight into the range of possible barriers and benefits for turning experimentation into adaptive management of the matorral.

We selected five different "stakeholder" groups in one of the experimental areas: the central valley south of Fray Jorge National Park and close to the coast. In addition to the three park scientists who were already involved in the experiments, we interviewed two private landowners, two small farmers in colectivos, three mining industry executives and two government policy makers (located in Santiago). In the interests of exploring the attitudes and concerns of these five groups, open-ended exploratory interviews were held with

several representatives of each group. It was our assumption that, in conservation in general and the El Niño experiment in particular, different groups who control potential experimental sites would be motivated to "buy" the concept for different reasons. Furthermore, following Rothschild (1999), we assumed that securing cooperation is not only a matter of education and persuasion, but fundamentally of exchange. Short of regulation or coercion, we assumed that we would find different patterns of motivation, opportunity and ability for involvement in the experiments among the different stakeholders involved. Risks and benefits would vary from one group to the next, but it would be unlikely that any group would be prepared to cooperate unless, at a very minimum, the risks and benefits were shared between experimenters and collaborators.

With this in mind, we conducted twelve interviews of about an hour each. Some were conducted in English and others in Spanish, with the help of translators. The interviews were recorded, transcribed and analyzed to understand possible motivations to participate or collaborate with the experiment. Our goal in conducting the interviews was not to provide a detailed picture of the sub-worlds of these stakeholders (which would be impossible with so few interviews), nor to build a grounded theory of stakeholder perception, but rather to uncover the variation that might exist between stakeholder representatives' motivations and attitudes towards the matorral. We asked questions first about their concerns relative to the physical environment in which they operated, about their perceptions of the value and importance of the matorral, and about their desire and/or ability to conserve the matorral. We concluded by asking what factors might increase their interest in participating in the experiment.

While the data gathered are neither a representative sample nor an exhaustive exploration of motivations, the data allowed us to make a preliminary identification of five distinct sets of concerns and motivations relative to the matorral landscape. The quotations that follow simply illustrate the complex motivational landscape revealed by Rothschild's social marketing framework. Further quotations are displayed in Table 2.

**Table 2.** Data display of stakeholders' expressed opportunities, abilities and motivations relative to El Niño experiments - additional examples.

Opportunity	Ability	Motivation
<b>Cooperative Farmers</b>		
<p>We have a reforestation plan. We know there is a program through the church. There are many alternatives we do not know – just the other day, I was reading there is a governmental reforestation program.</p>	<p>You need money to invest in reforestation. You have to reforest first and if 70% of the plantation is successful then you get 70% of the total investment; and if you succeed in 80% of the plantation after 3 years then you get 80% of the total investment back.</p>	<p>Q: Do you think that the amount of trees you have here has an influence on the microclimate you have?</p>
<p>We want it very much. Actually, we were fighting to organize a training school, so that professors could come and give talks, but we have not been able to get it. Look, the governor does not give the support to do it.</p>	<p>You have to go to them with a program of what you want to do, a management plan, that needs to be signed by a forest engineer. But in this region we have no forest engineer, so we are unable to do it. CONAF will support you if you go to them with a program but they will not come to you to help you do that.</p>	<p>A: Yes, it makes a difference. We see it every year with the fires: according to a technician decomposed air and smoke are forming a layer which does not let the moisture cross – we are missing the lung as we call it. We are old but we have to think of our children and grandchildren. It would be very easy to say that 'I am so old I am going to sell this land and enjoy the rest'. But we have to look back and remember our parents and grandparents who helped us to live and why would we be so selfish now?</p>
<p>We have received some foreign people here but later lost contact with them. As a society, we actually miss some support from the government. At present the government does not help people and organizations.</p>		
<b>Landowners</b>		
<p>The best of the farmers take very good care of the farms. They appreciate vegetation, they try to keep every tree alive as much as possible and to plant some, you've seen some eucalyptus. Not too bad. This is the only reasonable thing to do. I really think that if we were a rich nation, what a government should do is subsidize people who are able to stay here, and try to never touch a tree, maybe get rid of their cattle and keep this ecosystem alive and recovering.</p>	<p>It's very difficult to regenerate the natural vegetation. You can still see the beautiful native trees and the type of the vegetation that used to be in the high hills here. There is very little left now here. I knew a farmer who had a very beautiful, big farm and he cared about native plants. But he kept on selling pieces of land to survive; it wasn't economical. It was unsustainable.</p>	<p>It is very humid here, we have 90-98% of relative humidity every night and all these trees, the acacia and the ?? and the big meadows where there is acacia capture this humidity and return it to the soil to nurture the grass and it's self sustaining. This increases productivity at least at the beginning.</p>
		<p>The problem here is that people have the chance of selling for somebody who wants to clear the air a bit, make a nice tennis court, a swimming pool, a nice week-end house and he won't be able to do that. So there are big economic interests at stake which I think will make it difficult to implement a broad practice of conservation. If development keeps taking place and new roads and houses, you will eventually lose an important part of this.</p>

(con'd)

## Policy makers

The Chilean government will not respond much to any pressure because the issue of natural resources has not been an issue in the government. I hope that it'll be an issue at the end of this government. But right now nobody cares about this.

We might establish methods and procedures for integrating more natural areas into the (protected) system. But we would need to be strong, especially against the mining ministry because that minister puts more pressure on the systems all the time. In 1976 they were trying to get water from the Elauca. There was a big fight here. Now mining has been putting pressure on our protection of other areas.

It seems that matorral is distributed in a piece of territory which is densely populated. Most of the lands where we still see patches of matorral are privately owned, so you wonder what the alternatives are. Should the State try to establish protected areas or should the State implement stronger regulations on the private owners to require them to recover the areas that have been strongly affected?

One big problem, that's my personal impression, one big problem with the Matorral is that nobody cares too much about it. I work normally with people actively working to create legislation to protect the forest and even they don't care so much about this type of vegetation. In fact if you see the history of this discussion about native forest in Chile, matorral is completely absent most of the time. All discussions about the south or the central-south part of Chile. I would say in fact that CONAF, and a few people in NGOs are concerned about this kind of vegetation.

## Mining

We need environmental study before the regulation. All our permits for about fifteen years have included an environmental study, environmental evaluation. With time the studies are bigger – in the past they were few pages. But always we dedicate some part of our work to environmental study.

We need to remove all the installation, clean it and all the different things to try to return the area to the ambient state.

In this case the regulation is fine. We discussed with them to use, to consume this water in a forest and in an eucalyptus forest. Ideally we have about six million kilometers of water to use in a forest irrigation.

Each one of these has their own set of regulations with which you have to comply. Each agency that you described: the National Health Service, the DGA, all have their own regulations and you have to satisfy each of them.

Our case is very special because there are irrigation norms defining the quality of the water you can use in irrigation. There are no regulations for waste water. At this moment, there are no regulations for our kind of water, except irrigation norms and our water is not qualified for that.

When you are selling in an international market, and you receive criticism, you can have problems because some countries say we don't buy Chilean copper because Chileans don't take care of their environment. This is only going to get worse in the future. All big mining companies now need to manage the environment. We hire an environmental consultant for that.

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(con'd)

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## National Park Scientists

Some zones are called the nucleo of the park. In this nucleo is represented all the major ecosystems of the park, and that should be kept as pristine as possible. There are some peripheral areas around the nucleo zone which are called primary zone and this zone permits a certain kind of management for research and manipulations; they also include the place for visitors and for education. There is a completely new idea to incorporate into the park areas outside the park in which certain species could be protected, for instance all animals which are outside the park, and trying to incorporate the people outside the park in this eco-area.

Some people look at the phenomena of restoration in a very short time frame. For instance you have a plan to recover the forest, they want to see the forest improving immediately.

Now the congress is discussing the law of the native forest and this contain a lot of mistakes, because they are not using the advise of the scientists, because a lot of people give opinions without enough information background to make good regulations, to make good laws and that is one of the problems. Another problem in Chile is the media people who are not prepared to give correct information about science. You have, he general journalists, you don't have biologists. Some journalists who write about involved with ecology and biology, first should be a biologist and then be a journalist. Otherwise the information coming out in the media informs people incorrectly.

Another big problem is that nobody wants finance long-term studies. You have to keep modifying a little bit the objectives of the program or to add more objectives to keep the system working because they say OK we finance this project already. The people don't understand too much the idea to keep scientific experiments running because sometimes is very difficult when you say well I want to do a long-term study because after three or four years something can happen.

Really I'm very optimistic about the future. There is much more talk in Chile now about the environment problem, about... It's only been for the last five or six or seven years.... but I think this means there is a big potentiality in using this scientific knowledge for management policy, specially or at least at the beginning for plant regeneration. The idea that we are discussing the paper is, it comes from a lot of experimental resources. During the El Niño you have this big opportunity, there is an increase preservation and the idea we are discussing is that if we put all the effort in restoration during this opening, this time window we have, during el Niño we can trigger a change and that could have potentially, I think, an important policy effect.

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## STAKEHOLDERS IN THE MATORRAL

### Private land owners

Between 30% and 40% of the matorral lands have traditionally been in the hands of large private landowners (Zeitlan et al. 1976). In some cases, this dates back to land tenure agreements made by Spain during colonial times. These families are not threatened by environmental regulation, although in the past, agrarian reform has forced them to parcel out some of their land to small farmers or to take measures to protect it (Bellasarío 2007). Today, the farms are maintained for sentimental reasons, for tourism, and often as an investment.

*Well, now I have only two hundred and fifty hectares, but this farm is around five hundred and sixty hectares. I've split it and handed part over to my children. They don't live from this, they earn their money elsewhere, but they love this and inject money and do things. Fortunately in this area, lots of this is happening. The farms (do not) have the capacity to generate income. They have another value, a sentimental value and a tourist value. But there is no relation whatsoever between the price of a hectare here and the capacity for generating income - nothing. I think that economically, all of these farms here, except a couple a little bit up in the hills which have*

*tree plantations, are uneconomic. You don't make money from the farm - no. So, people who own these properties either have to have independent wealth or they make their money otherwise. So, in a sense, they become almost like hobby farms, or vacation properties as opposed to income generating properties (Interview with large landowner).*

In interviews, these landowners expressed a sentimental "love of the land" and a desire to maintain it "for our children." When queried about whether restoration and reforestation of the kind envisioned by the El Niño project appealed to them, the conversation quickly turned to economic feasibility. The increased dryness of the past few years has had negative effects on agricultural productivity. In the coastal region where this study was carried out, only the flat lands were available for cultivation (lentils and wheat) and grazing. On the hills, trees have been used for producing charcoal. However, with the increasing emphasis on tourism in the area in recent years, by far the most profitable use of the land is in development. Chief struggles have been over what kind of development will occur in the areas designated "urban." The large landowners seemed unlikely to sacrifice land for parks.

Appeals to the heads of such families to donate land for experimentation would probably have to rest on the following factors: a) sizable government subsidies - unlikely until ecosystem restoration is a higher priority; b) appeals to family pride and tradition - these would need to focus on families where some of the land has been kept intact as matorral; or c) scientific persuasion about the value of forests for increasing humidity in combination with perceptions of increasing drought in the area, persuasion about the value of increasing biodiversity, and appeals to aesthetic values. Of these, the second is worth further exploration, because the chance to sell eligible land for recreation development means that economic incentives favor development rather than conservation. Where the families are old and have wealth unconnected with the land, they may be motivated by tradition or family pride to keep or restore the land to its original state. Such a decision would be fairly straightforward; if the head of the family wishes it, the land would be available for protection and experimentation. It should be remembered,

however, that such decisions may be capricious and are easily reversed.

### **Communal agricultural farmers**

In the period of agrarian reform around 1965, a number of farmer cooperatives or "colectivos" were established in Chile (Bellisario 2006, 2007, Altieri and Rojas 1999). These are groups of small landowners, each with separate plots that they manage separately. Broader issues of marketing and land management are brought to the cooperative for decision-making.

*This was started with the Reforma Agraria process. In Chile, in 1965, the Reforma Agraria was a very advanced process because it gave dignity to the small farmers, first of all because before that these houses did not exist, they were just "ranchos de techo" [very poor houses made out of mud with a roof made from the leftovers of wheat plants after the crop]. The Reforma Agraria process woke up the interest of the farmers. Before that, we were all "medieros." That means that only 1/4 of the production was for the farmers and 3/4 for the landowners. We never knew how to sell our products, only the owner of the land knew how to sell. Everything you produced you gave to him - potatoes, beans - and he would sell them. He would do the bookkeeping and if at the end there was some extra left then you would get some money, but many times he would just say, "We are settled now." That was also because the great majority of the farmers were illiterate (Interview with small landowner organized in a farmer cooperative).*

Generally, the problem for communal agriculture is the lack of water. Despite their expressed awareness of (and attachment to) the native vegetation and their understanding of the value of reforestation, they perceive themselves as blocked because of the expense. The Corporación Nacional Forestal (CONAF) requires a forest engineer to approve reforestation projects and offers subsidies only afterwards and only when a high rate of tree establishment has been achieved. Both conditions are difficult for farmers' cooperatives to meet. For example, in the studied area there was no forest



engineer available, and the colectivo already had a considerable debt. Perhaps the greatest barrier, however, is the high percentage of success demanded by the government. The communal farmers are not rich and cannot afford to give up any land currently used to grow avocados that are sold by cooperatives on the world market.

The native species of the matorral are not perceived to be of much inherent value (Silva 1997), and because the available subsidies for native forests can also be used for plantations, farmers are prone to move toward higher value crops. Nonetheless, unsustainable agricultural practices of avocado and other orchard products have seriously compromised the vegetation (Armesto et al. 2009) and soil condition in Central Chile (Castro-Ríos and Espinosa-Toro 2008). The farmers recognize the value of trees in conserving water, but they would need hefty subsidies to be willing to give up land for experimentation purposes, unless that land was of no agricultural value. Even then, ensuring that the land was protected from grazers, especially rabbits, for the appropriate time span would require external resources.

### **National park scientists**

In Chile, a broad range of protected wildlife areas fall under the National System of Protected Wildlife Areas (SNASPE) administered by the National Forestry Corporation (CONAF). While it would appear that experiments on governmental protected land would be fairly straightforward, the system of park management is complicated and scientists associated with a park have, in many cases, strained relationships with the park management. Park scientists already involved in some conservation projects stress the lack of understanding about long-term science projects, the competition between university and park based scientists for funding, and the lack of rewards (both financial or prestigious) attached to a career in environmental science in Chile. Scientists feel caught in a complicated web of relationships that must be managed for them to get their work done. In general, the system of protected areas is part of CONAF, which in turn is part of the Ministry of Agriculture. Due to the complex nature of negotiations at the highest level, scientists operating at the level parks are subject to constant political vicissitudes. Maintaining good relationships with park management and local communities offers some protection, but neither

park managers nor locals have much understanding of scientific principles and methodologies.

*I've seen that one of the difficulties is there is no link between science and community, no good bridge, because we're not prepared to inform to the community about what we are doing (Interview with a park scientist).*

The scientist who wants to create space for social transformation needs to build and maintain bridges with stakeholders outside the park. Park scientists may also need to deepen their understanding of the political imperatives of park managers, including tourism and agriculture, if they are to gain support for long-term experimentation. Experiments that threaten these interests may be hard to "sell."

*There are not many connections between scientists and policy makers. Now the interaction is increasing, but not too much yet because there is a different language of scientists and policy makers. Another comment on institutions like CONAF, CONAMA is that there are not many technical people working there. Those institutions are directed by politicians, the director of the institution is political. That makes the communication difficult between scientists and directors (Interview with a park scientist).*

Park scientists are certainly likely to be motivated to collaborate even in the absence of incentives, consistent with a history of long-term ecological experimentation in national parks made possible by good communication between scientists and managers (e.g., Fray Jorge National Park). Their training also gives them the ability to do so. However, the opportunity may be constrained, either by policy makers higher up in the system (responding to political pressure) or by local stakeholders who misinterpret their experiments. Therefore, they will likely need support from the experimental scientists in building motivational bridges with colectivos, industry and landowners, and in supporting the creation of new environmental protection laws (discussed below). Moreover, they rely on the pressure for policy change created by international environmental groups:

*Several important countries and other countries have been asking for environmental*

*laws. So there is external pressure on the government to introduce this. There are several environmental organizations such as Green Peace, there are Green Parties, and also in the Senate there are certain legislators that are more concerned about the environment. People are more aware now of environmental problems than they were ten years ago. Ten years ago, nobody talked about environmental problems. Now you also have the newspaper, TV and radio, so more people become involved with environmental problems. The governmental change in policy has been more influenced by external pressure than by the internal awareness of scientists and environmentalists (Interview with a park scientist).*

### **Foreign resource extractors**

Resource-based industries such as mining and logging dominate the Chilean economy. Environmental regulation in Chile is not particularly strong, and there is evidence that much of the existing regulation favors economic development over protection (Clapp 2001). Foreign companies operating in extraction industries within Chile are subject to more stringent environmental laws than national companies, despite the absence of pressure from NGOs (non-governmental organizations). Such pressure is common in many parts of the world. Indeed, based on interviews with managers of an American-owned mining company in the area, it seems that pressure at the international level causes some companies to voluntarily exceed local limits and self-impose restoration requirements. The positive image that results can offset or mediate the kind of negative publicity that has affected the stock prices of companies such as Shell (Nigeria) and Talisman (Sudan).

*When you are competing in the international market, you can have problems because some countries say, "We won't buy Chilean copper because they don't take care with environment." I see this in the future. And in the end all the companies, the big companies, the big mine companies will have the same problem. We plan to stay here for about forty years. At the moment in Chile there are regulations, but our company is American and defines the principles we need to remove all the*

*installation, clean the installation and all the different things needed to try to return the area to the ambient environment. We were approved two years ago for an expansion, and received the permit for an expansion of this mine. We had no opposition. In general, our company has very good record and has a very good relationship with the authorities (Interview with mining company executive).*

The mining company officials interviewed for this study indicated their commitment to restoring the mining site to its original condition within 40 years. The excess water used for processing minerals could be used for maintaining the restored system. However, there was some concern that the site would not be suitable for indigenous plants due to high levels of copper and sulphate deposits (see Table 2). Permits would be required from multiple government agencies and there would be additional costs for fencing (to keep out rabbits) and possibly for purifying water. In theory, given the reputational incentives for mining companies, uncontaminated sites within their properties should be promising targets for reforestation experiments.

### **Policy makers – CONAF**

Unfortunately, the policy makers interviewed for this project did not see high "value" in the native evergreen shrub lands (see Table 2). The policy makers' opinions mirrored those of the Chilean government, which does not prioritize the environment. While it was within their purview to protect natural areas, the perceived worth of the matorral was not high enough, and the effort would fly in the face of more powerful ministries responsible for mining and urban development. Nor did they feel that the matorral was of much interest to the general public, apart from some NGOs. Overall, there was little motivation to invest in changing the situation.

The conclusions of the policy makers interviewed are particularly problematic for the future of the matorral. CONAF has the ability to provide both positive and negative incentives, and thus has the power to create the exchange that is crucial to successful social marketing. Here again, however, as the scientists and mining company executives noted, the international community has a key role to play. While scientists struggle to make the importance of the matorral more evident to all

involved communities, the policy makers concede that pressure from the international community has the greatest potential to influence policy in the near future (see Table 2).

## DISCUSSION AND CONCLUSIONS

In summary, the exploratory interviews suggest that the likelihood of collaboration varies significantly across the five different groups sampled (Tables 2 and 3).

Viewed through Rothschild's framework, it appears that the large landowners have the ability and the opportunity to provide sites for experimentation, but what would motivate them to do so? If family pride is key, a landowner might be motivated if promotional materials gave him widespread recognition. To the extent that the individual landowner is interested in tourism, a restored matorral might provide him with additional "eco-tourism" resources. In all cases, however, some considerable financial outlay on the part of the experimenters might be required, if only to ensure publicity for the participation.

The farmers' cooperatives have neither the opportunity nor the ability to turn over land for experimentation. Their motivations for participating would almost surely involve an exchange, not just in the form of a subsidy but also in the form of expertise. Again, a monetary outlay could be anticipated. However, finding alternate economic uses for the matorral and providing training and expertise might also improve the chances of persuading farmers' cooperatives to participate (see Garrity et al. 2002).

The stakeholder group most likely to support such a collaboration might be the international mining companies, if they felt they could gain political support and greater freedom of action by participating. Viewed from Rothschild's perspective, the exchange of risk and benefits between the mining company and the experimenters might be the most equal. They have the ability and opportunity (in the demand for environmental stewardship) to take on such an experiment. Furthermore, the very act of entering into the collaboration would signal their willingness to act as good environmental citizens, which would ease the way for future operations.

The National Park scientists, whose inherent motivations would be closest to those of the experimenters but who are constrained by the highly political nature of their position, are also likely to support such a collaboration. Private landowners are potential (but unstable) partners, and the farmers' cooperatives would need the most support in terms of skills and resources. However, in the long run, if El Niño-related restoration projects were to be implemented on the expanded scale desirable, all of these groups would need to play a part. For this to happen, both "bottom up" and "top down" strategies would be required. The low motivation expressed by policy makers emerges as a key challenge. The stricter environmental policy governing mining practices has clearly opened a window for experimentation and innovation in environmental management (Westley et al. 2006), and the government and the mining companies are particularly sensitive to international censure in this arena. When it comes to the matorral, how will such international censure be raised?

The matorral is one of the 33 global hotspots of biodiversity (Myers et al. 2000). The matorral is not much valued by Chileans, who tend to see it as an "unused," "unproductive" land covered by "shrubs" and poorly protected in the national system of conservation areas (Armesto et al. 1998). However, an argument can be made that the matorral provides ecological services (such as regional climate regulation, soil and biodiversity conservation) and aesthetic value. During the past decades, land cover change in central Chile has been driven by intensive agriculture directed to external markets (Altieri and Rojas 1999; Armesto et al. 2009). Expansion of orchards on hillsides combined with the complete removal of plant cover and unsustainable agricultural practices have increased soil erosion and seriously compromised the productive capacity of these ecosystems (Armesto et al. 2009). Current assessments estimate that 60% of the country's territory shows signs of soil erosion that directly affects 13% of the Chilean population (CIREN 2009). The avocado and vineyard plantations are the clearest examples of these trends.

Recent research has estimated that ecosystems in their natural or "wild" state are approximately 100 times as valuable in terms of total ecosystem services as the same land in a state transformed by humans (e.g., mangrove systems versus shrimp cultures, wetlands versus agricultural lands, etc.) (Balmford et al. 2002). But how can these insights

**Table 3.** Opportunity, ability and motivation for collaboration in El Niño experiment

	Private landowners	Farmer Cooperatives	National Park scientists	Mining company	Policy makers – CONAF/ CONAMA
Opportunity	Yes	Constrained	Constrained	Yes	Constrained
Ability	With training	With training	Yes	Yes	Constrained
Motivation	Recognition	Resources and training	Learning/ restoration	Reputation	Political will; international pressure
Overall preparedness for collaboration	Low	Very low	Medium	High	Low

be tailored to fit the motivations of these stakeholders? Both the small farmers and the landowners recognize that trees capture precious moisture. Could scientific comparisons be made of the moisture-retaining properties of the matorral versus a tree plantation? Would such studies further capture the international imagination?

Marketing the "El Niño restoration approach" is a further challenge, for both short-term and long-term reasons. In the short term, it involves convincing local owners to collaborate in a restoration project. Although the success of forest restoration by one group may lead to acceptance of the idea by another group, it is not necessarily true that success in a park setting will trigger acceptance of the approach among farmers or landowners. In the long run, if the El Niño restoration approach is to be implemented on a large scale, a flexible and coordinated plan will need to be devised—one backed by government policy that can be quickly implemented when El Niño is announced. This could take the form of a simulation; however, while simulations have proved valuable in training for response to disasters, their application is less promising in contexts where no emergency is perceived (Edwards 2009).

Perhaps, given the attachment to the land expressed by the small farmers and landowners as well as the need for collaboration and for a broad-based action plan, a participatory planning process should be attempted. Reforestation programs in Chile are usually prepared in advance, based on average conditions (e.g., institutions plan to reforest a certain number of hectares per year). Using El Niño for

ecological restoration requires agencies to save their effort and invest it in the short periods of time when climate conditions are right. It demands that all participants in the process change their way of thinking. While it goes against the mainstream of policymaking in Chile, "whole system" planning processes (such as future search and scenario planning) have proved effective in a number of instances, from the managing of endangered species (Westley and Miller 2003) to ecosystem assessment (Millennium Ecosystem Assessment 2005) to Scandinavian transportation systems (Leleur 2007).

Case studies from other areas of the world have suggested that restoration of degraded ecosystems, if built on the involvement and cooperation of local stakeholder groups, is feasible, but difficult (Orlove and Tosteson 1999; Holmgren 2009). In addition to the "whole system" planning processes mentioned above, the involvement of local groups in both collecting and interpreting scientific data would build social capital by linking local groups together and help stimulate an approach broad enough to allow for multiple interests to be met (Pinkerton 1999). In the case of Chile and the matorral, such a scenario is close to the one identified and described by the government scientists. It would mean making the science transparent to local groups and building bridges between large landowners, farmers' cooperatives, managers and corporate actors. It would also mean recognizing that the motivations and interests of these stakeholder groups are different and that the benefits must be equally shared.

Further research is needed to answer the questions raised by this paper. Clearly, in the case of the landowners and the colectivos--those with the least incentive to cooperate in the present system--a legislative change to reward restoration would help tip the balance. However, continuing pressure from the international scientific community and international NGOs appears to be necessary to increase the value of such legislation for the policy makers themselves.

While complex environmental challenges are difficult to understand and even more difficult to manage, we have raised the possibility in this paper that social marketing in general, and Rothschild's framework in particular, offer practical insights into the trade-offs and policy interventions that might help move a system towards conservation. We acknowledge that social marketing is not a panacea. Nonetheless, it needs to be added to the development literature like other approaches that are better documented, such as participatory management and community-based management. Its contribution, however, is that it reveals the significant differences in motivation that characterize different social groups concerned with or affected by conservation imperatives. As such, social marketing can provide a source of further insight for those dedicated to restoration in complex social contexts.

Responses to this article can be read online at:  
<http://www.ecologyandsociety.org/vol15/iss3/art6/responses/>

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