Progress Report II

PROJECT

Restoration of temperate forests in the southern Chile: integrating ecological and socioeconomic variables.

Rufford Small Grant

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1. INTRODUCTION

The few restoration experiences implemented in Chile have been developed almost exclusively on large properties, arguing that the need for subsistence and migration make impossible to establish this type of experience in small properties in medium and long term. This report describes the results of the first experiences of forest restoration with small landowners in Chile. Design, implementation and monitoring of restoration programs were implemented with the active participation of owners in each stage of the project. This experience provides the basis for the development of effective tools for restoration and conservation of forests and to improve the wellbeing of the rural families. The success of this project will motivate the development of restoration projects to a larger scale with small landowners.

The report is organized in four sections: selection of properties, restoration experiences, project assessment, and future activities.

2. SELECTION OF PROPERTIES

The forests of the Northern area of the Coastal Range are mostly degraded respect to the forests of the Southern area. The Northern area is characterized also for concentrate the rural communities of this Range. These levels of degradation have resulted in the loss of streams, low productivity of soils and loss of biodiversity, including endemic and threatened species (fig. 1). This territory also presents one of the highest rates of substitution and fragmentation of original forests of the Región de los Ríos due to plantations of exotic forest species. The northern area however concentrates the largest properties and native forests in better state of conservation. Some of these properties are now part of private protected areas and span over 60,000 ha.

For the implementation of restoration experiences two rural communities in the Northern area of the territory, Futa y Lomas del Sol, have been selected (fig. 1). These communities were selected after interviews and workshops applied in the study area, through the application of multi criteria analysis techniques.

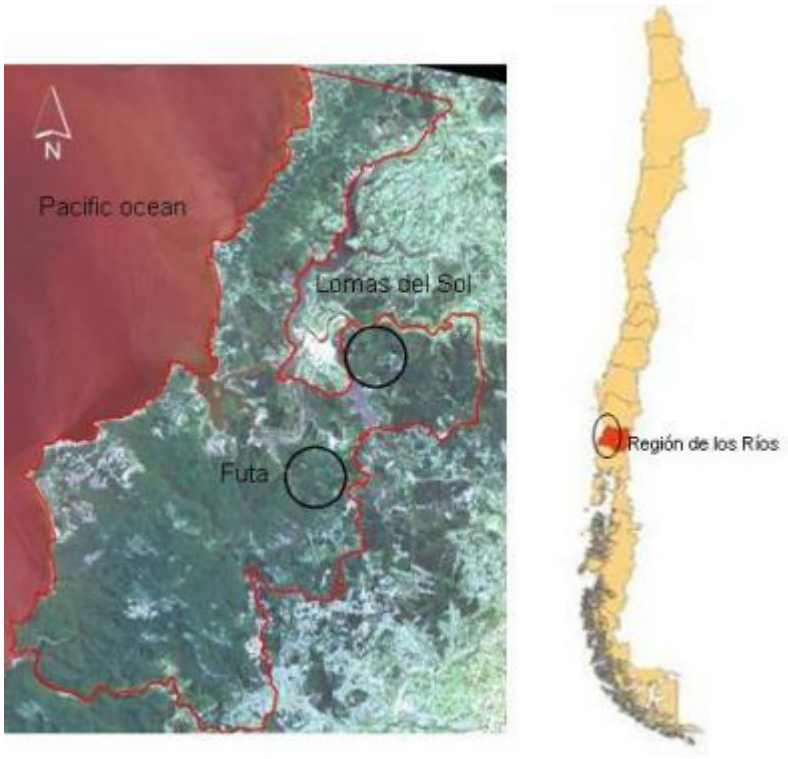

Figure 1. Coastal Range of Región de los Ríos and rural communities selected to implement restoration experiences.

Both communities have a high interest in the conservation and restoration of native forests; they also have strong social organizations and previous successful experiences in rural development projects, mainly promoted by government agencies. However, these projects were principally intended to promote livestock and agricultural activities and generated a high impact on soils characterized by thin fertile layers, heavy slopes and high erosion rates. (fig. 2) In this area, it is also common the presence of exotic plantations of forest enterprises in large properties (fig. 3).

One of the most serious consequences of the current degree of forest degradation and the advancement of industrial forest plantations is the high level of poverty and migration of rural population to the urban centers, which also corresponds to reality experienced by the communities Futa and Lomas del Sol. The rural families are characterized by a subsistence rural economy that depends mainly of firewood production and livestock. In this area the loss of streams and springs, main water sources for rural families, by the loss of forests and exotic plantations increased, forcing the local municipality to deliver water by truck, something unthinkable a few years ago in a Region with an annual rainfall of 2,500 mm. Furthermore, the lower productivity of the soil and intensive livestock does not allow natural recovery of forests, which in general have lost much of its structure and original composition

Figure 2. View of the river Futa before and after an intense rain. The comparison shows the high level of erosion in the territory

Plantations are promoted by the State in rural communities without considering the restoration of degraded native forests as an alternative not only for the recovery of these ecosystems, but also for the restoration of soils, streams and biodiversity, critical ecosystem services to the livelihoods of rural families. Moreover, forest restoration could represent a productive alternative for small land owners. Since firewood is currently the main source of energy both in the Region and the South of Chile, and this activity can become an important source of income for rural communities and a sustainable activity if the small landowners have an appropriate and permanent technical support.

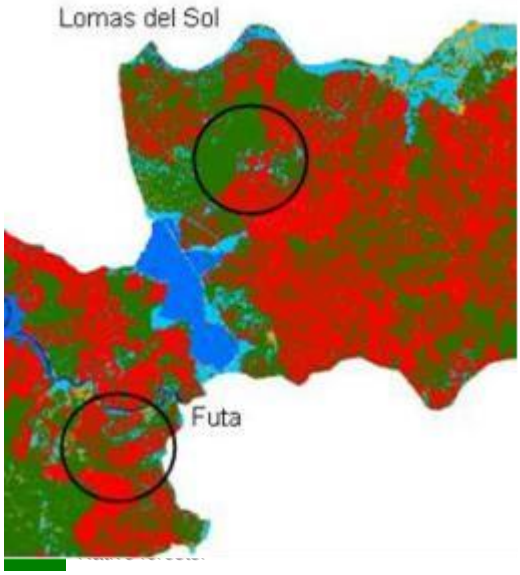

Figure 3. Distribution of native forests and plantations of exotic species in the territory

3. RESTORATION EXPERIENCES

Selection of the pilot restoration areas. 20 smallholders were preselected and tested. During the visits to the properties it was discussed *in situ* the feasibility of implementing a restoration program. Three parametrs were analyzed: first, landowners' interest in participating in initiatives to restore and conserve forests, then the level of dependency of farm production and finally the state of forest degradation. Thus, in some properties the possibility to migrate was very high, and even the same owners expressed their intention to sell the property in the short term. On the other hand, in other properties observed an inconsistency between the intentions of conserving and restoring native forests and intensive livestock production practices.

Were finally selected 9 small landowners, 5 of Futa and 4 of Lomas del Sol community, with a total restoration area of 15 ha (Table 1). This area considers both active restoration areas as passive restoration. Passive restoration areas are those that were eliminated sources of change as livestock by the establishment of fences and the abandonment of the practice by the owners.

Table 1. Restoration area by property and rural community.

Rural community	Restoration area by property (ha)					TOTAL
Lomas del Sol	0.8	1	2	1.2	-	5
Futa	2	2.5	2	1.8	2	10
TOTAL						15

Based on the general visits of the properties and the interviews with each owner, we obtained an overall assessment of the environmental and socioeconomic characteristics. The environmental assessment included several features of the properties as classes of land use and the conservation state of forests. The socioeconomic assessment considered issues such major productive activities, income from external sources (subsidies, salaried jobs), and previous experience in other projects.

Design. In each restoration area a general description and evaluation of the vegetation was carried out. We designed a protocol which defined clearly each of the aspects to consider in our restoration activities, and for the proper monitoring of each of these experiences.

In each restoration areas bands perpendicular to the slope were defined and established (fig. 4). Each band had a width of three meters, with a minimum of four meters between each. In these bands we identified several conditions and composition of vegetation coverage replicable between bands, that we called “replicable condition”. In each "replicable condition" we established a sample plot of the width of the band, and with a length of between 4-5 m (defined *in situ*). These plots were used for planting activities. In each plot the following variables were recorded: a) forest regeneration by species in four height strata (0-0.5 m, 0.51-1.0 m, 1.01-1.3 m,> 1.3 m and dbh <4 cm); b) species richness woody; c) coverage of all species in four height strata registered as like the regeneration. Mosses and lichens were included. We identified species, the strata and coverage on the ground occupied by each species; and d) anthropogenic disturbances. We recorded the regeneration with browsing damage (livestock and / or rabbit), the number of domestic cattle trails and the presence of alien species.

Figure 4. Example for the establishment of bands and plots (restoration experience in community of Futa). Each color and number represents the sample-planting plots defined according to the same “replicable condition”. The design, number of bands and plots were defined according to local conditions.

From the central axis of each band, at a distance of three meters on each side, we recorded the number of cattle dung pats and number of tree stumps by species and age range (1: 1-5 years; 2: 5 to 10 years; 3: > 10 years). Based on the information of vegetational characteristics of each restoration area were defined tree species, type of plant nursery (container or bare root), density, composition and planting design with the continued participation of the landowners. Thus, the restoration experiences integrate local needs and interests, as well as the characteristics of each area to be restored.

Implementation. All restoration areas were fenced with wire and mesh (plastic or metal) to prevent access by livestock (sheep, cattle and goats) and rabbits (fig. 5). Details are given in Table 2. Planting activities were performed on sample plots established in each of the bands. Planting was done with a density, spacing and combination of species defined *in situ*, which was maintained between plots with same "replicable condition". For each "replicable condition" we remained plots without planting as control plots. In all plots was conserved the regeneration of tree species established naturally. Each restoration experience was carried out with the support of the communities.

Figure 5. Fenced area to prevent the attack from cattle and goats (community of Lomas del Sol).

Table 2. Characteristics of each condition of restoration.

Condition	**No. of properties**	**Characteristics**
A	1	**Plantation of exotic species (*Pinus radiata* and *Eucalyptus nitens*).** High density of natural regeneration of native species (trees, shrubs). Soils well preserved, moderate slopes.

B	2	**Grasslands.** Deforested areas for agriculture and livestock. Flat area and temporary high water level.
C	2	**Forests with high degradation.** Overexploited forests for timber production, firewood and livestock. These areas have varying conditions of surface, with different forest cover, density and type of regeneration (tree, shrub, etc..). Soils with different states of preservation.
D	3	**Forests with medium level of degradation.** Overexploited forests for timber and firewood production, but have not been exposed to intensive livestock. Areas with different successional stages of vegetation, with a variable density of natural regeneration. Soils generally well preserved.
E	1	**Areas recovered naturally.** Overexploited and previously burned area, but with a dense and vigorous natural regeneration of different forest species.

All plants correspond to native forest species. Although they are of known origin, they were produced from seeds of other localities in the Region by the nursery of the Faculty of Forestry at the Universidad Austral de Chile (fig. 6). Depending on the specific characteristics of each plot, were used species with different shade tolerance, and both bare root and container. Table 2 shows the details of each general condition defined in the field.

In total we planted over 3,300 plants, most of which correspond to the three most characteristic tree species of the territory: *Nothofagus obliqua* (roble), *Eucryphia cordifolia* (ulmo) and *N. alpina* (raulí, Table 3).

Table 3. Surface area and number of plants used by species and restoration area

Condition	**Surface**	**N plants**	**Forest species**
A	2	400	*N. obliqua, E. cordifolia* (bare root and container), *Nothofagus alpina*, *Gevuina avellana*.
B	1.5	142	*E. cordifolia* (container)), *Fitzroya cupressoides*, *Sophora microphylla*, *Amomyrtus meli*, *Drimys winteri.*
B	0.8	100	*E. cordifolia* (bare root), *G. avellana*, *A. meli, D. winteri.*
C	2.5	600	*N. obliqua, E. cordifolia* (bare root), *N. alpina, G. avellana*.
C	2	470	*N. obliqua, E. cordifolia* (bare root and container), *N. alpina, G. avellana*.
D	2	275	*E. cordifolia* (bare root and container), *N. alpina*.
D	1	500	*N. obliqua, E. cordifolia* (container), *A. alpina*.
D	2	500	*N. obliqua, N. alpina.*
E	1.2	400	*N. oblicua, N. alpina.*

Training activities were conducted on different topics such as the role of forests beyond timber production and planting techniques of native forest species. Furthermore, in the visits carried out in each area of restoration, the owners were trained in the selection of appropriate species according to the characteristics of each site.

Figure 6. Nursery plants of *E. cordifolia* (container) used in restoration experiences

4. PROJECT ASSESSMENT

STRENGHTS

- This project is the first experience in Chile of forest restoration in rural communities that integrate this diversity of local conditions and owners. This represents an opportunity to explore the different issues and possibilities in the development of such initiatives with small landowners to promote the interest of rural communities in conservation and restoration of forest through a “domino effect".

- This initiative was developed with the active participation of the owners, and implementing through a field protocol allowing adequate monitoring of each experience. This information will allow us to maximize our learning of this unprecedented initiative in Chile. This learning will be essential to increase the restoration area both in these communities and in others, our next step in the future. Along with this, the proper systematization of the information generated by this project and the monitoring of each restoration experience will allow us to disseminate the results through talks and technical and scientific publications.

- It expects to recover the structure and composition of the ecosystems, as well as, in the medium and long term, critical ecosystem services for the rural families. This territory is characterized by high rates of loss and degradation of native forests, and for the support of the State to unsustainable production practices on a large scale by the characteristics of the territory (plantations of exotic forest species, livestock and agriculture).

CHALLENGES

- Small landowners, unlike large properties, need each hectare for the family subsistence. In this context, most of the few forest restoration experiences in Chile are being

implemented in large properties. In these properties the less pressure in the forest would facilitate the maintenance of these projects in the medium and long term. Even some researchers argue that it is impossible to restore forests in small properties by the production requirements and lack of commitment of the rural families.

- One of the main challenges of our project is to integrate the restored areas in the rural production system, as a direct and indirect source of ecosystem goods and services to improve the wellbeing of the rural families.

5. FUTURE ACTIVITIES

Based on the results of this pilot project, in a second stage we expect to continue implementing restoration programs with small landowners on a larger scale. Moreover, we expect to increase the restoration surface in each property. Also, we expect to develop the next activities:

- Monitoring of diversity species of flora and fauna.
- Evaluation of ecosystem services (erosion, biodiversity, water production).
- Production of plants in nursery of Futa community and construction of a nursery in Lomas del Sol community for future restoration activities.
- Training in seed collection and plant production.

For monitoring and evaluation of each of the restoration experiences will be measured annually the following variables:

- Species richness of flora.
- Forest cover.
- Dasometric variables. Basal area, DBH, height.
- Natural regeneration. Species, diameter and height.
- Presence of exotic species.

To continue implementing restoration experiences in the territory would support the development of projects that integrate scientific and technical knowledge with the local interests and needs. The diffusion of these experiences and the growing interest of the rural communities in the forest restoration certainly will encourage research centers, NGOs and government agencies to consider restoration as an alternative to mitigate and reverse the process of degradation of native forests, and thus to improve the wellbeing of thousands of rural families who depend on forests for their livelihoods. In turn, this allows us to create spaces for discussion and debate so that the restoration can be considered a relevant discipline to the recovery of forests ecosystems and the wellbeing of the society in general and of the rural families in particular.