The Rufford Foundation

Final Report

Restoration and management of Queñua (*Polylepis racemosa*) and Pino de Monte (*Podocarpus glomeratus*) woodlands in the Yungas of Independencia, Bolivia

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1. Introduction

P. glomeratus and *P. racemosa* forest at Norwest of Cochabamba, Bolivia are vulnerable to the burning, domestic herbivorous and the felling of communities. The causes are due to poor knowledge of the people about these species and its benefits, the lack of agreements among users to protect and use the forests, and the little ecological knowledge to reforest these species. The first and second RSG project promoted the environmental education, the creation of local agreements to use and protect the forest in two communities and the reforestation of these species. In this boaster project intensified these activities carrying out the follow activities:

a) Environmental education: The local people (teachers, students and community farmers) will get familiar with the biology, ecology and the problems of conservation of *P. glomeratus* and *P. lanata*, in order to be able to design and prioritize new practices and policies for their protection.

b) Facilitating local agreements: At community level, I evaluated the knowledge and the compliance level of local norms to protect and use the forest of *P. glomeratus* and *P. racemosa* in three communities. They will analyse their strengths and weaknesses and will make new agreements among them. At municipal level, I facilitated workshops to regulate the actions and responsibilities of local organizations (schools, communities, municipal government, NGOs and others) to protect and use the forest of *P. glomeratus*, *P. racemosa* and other formations of native vegetation.

c) Recovering the forest: I followed working to increase the cover of these species carrying out plantations. Some plants were planted with experimental designs to continue learning about the survival and growing of these plants. In order to I collected seeds and cuttings from the forest, produced plants in a local nursery, reforested in old and new places carrying out new experiments to evaluate variables that could influence survival and growth of plants as the different vegetation covers, substances of growing (mycorrhizs, fertilizers and bio stimulants) and origin of plants (cuttings or seeds).

2. Method

a) Promote the environmental education in schools and communities

First, we carried out an evaluation of the environmental education situation of the in three public schools in Independencia. Many teachers are new each year, coming from other localities, and few teachers have lived in the municipality for a long time. Therefore, the principal limitations were that the teachers do not know the local environmental problems, and even less about the problems of the forest and their species. However, some of them were motivated to work in environmental education, but still without a lot of information and tools to teach to students (the environmental education had been reduced to recycle garbage and caring for the school). Thus, we carried out five workshops with them, to propose and design a curriculum to include main themes about environmental education in the class for the long-term (local extinction species, benefits and causes of overexploitation of native forest and trees, soil erosion, fertilizers and pesticides, and community norms to protect the forest). Two workshops were carried out together with professionals of FUPAGEMA and the municipal

government (Fig. 1). In addition, three guides with these specific contents were created and distributed in the school libraries. The guide is used by them this year.

Fig. 1. Workshop with teachers of School Boliviano Aleman.

We organized three environmental fairs in the main village (Villa Independencia) to teach the experiences of local policies, the use and protection of the forest, and reforestation, with teachers and students of schools (Fig. 2).

Fig. 2. Fair on importance of native plants and wildlife of Independencia, with the participation of students and teachers and other local organization.

We produced and diffused nine new radio programs about conservation of the cloud forest, forestation, and local experiences in forest management in station radio "Domingo Savio". In addition, we intensified the dissemination of all the radio programs produced by the RSG project in other local radio station "Guerreros de Independencia" in order to reach more listeners and have more impact. We have included real cases and this was liked by lot of the people. For example, leaders of communities of Pajchanti and Salviani went to the recording studio to record four stories in their own words and language about the cutting and burning of forest and the regulations of their communities. Also, we identified other local cases through of interviews of local people, and these were converted into radio programs as well. Then we carried out interviews at the people of the municipality (60 people children, teenagers and adults) in order know if they heard the programs and received their comments.

b) Facilitation local agreements to the community-based forest management

We carried out interviews to authorities and professionals of municipal government and two NGOs. Also, we carried out one focus group with professionals of the municipal government. Also, we had semi-structured interviews and workshops in three communities (Pajchanti, Salviani and Palermo). We did workshops with the responsible professionals of forest and agriculture of the municipal government. On the other hand, the communities evaluated the accomplishments of their regulations on the forest and analysed their weaknesses and strengths. They also asked for our cooperation in reinforcing the regulations again, and we accepted the request (Fig. 3).

Fig. 3. One workshop in the community Salviani evaluating accomplishment of norms on the forest (weaknesses and strengths).

Also, we organized two workshops with leaders of communities of the municipality together with FUPAGEMA in order to evaluate the work of the norms to use the forest (weakness and strengths). As result, proposals emerged to improve the forest control and strengthen the participation of local government and communities. Some of these ideas are been promoted by FUPAGEMA.

c) Recovering of the native forest

We produced 10.500 *P. glomeratus* and *P. racemosa* plants and other native species in the nursery (Fig. 4). However only 7000 seedlings were planted. Some *Polylepis* plants were attacked by the *Peronospora* sp fungi (approximately 2000 plants died) and other *Podocarpus* and *Polylepis* plants did not achieve a good size to plant (approximately 1500 plants).


a.

b.

c.

d.

Fig. 4. Collect of *P. racemosa* seedlings of natural regeneration (a). Propagation of *P. glomeratus* cuttings in nursery (b). Propagation of *P. racemosa* cuttings (c). Application bio-stimulant on *P. racemosa* in plantations (d).

The seedlings of P. *racemosa* were planted with different treatments of fertilizers, near and far from native shrubs. In two areas (In Salviani on grassland and in Palermo near two springs). Seedlings of *P. glomeratus* were planted in different microhabitats (grasslands, disturbed forest and old forest) in Pajchanti and Palermo (Fig. 5). We produced plants through cuttings and seeds, these factors were also considered in experiments. Monitoring will be carried out each year with the FUPAGEMA organization.

Fig. 5. Plantation of *P. glomeratus* near of shrubs in Pajchanti

We also evaluated the plantations in Pajchanti carried out earlier (in the year 2010). Currently, we have a 40% survival of *P. lanata* and 30% of *P. glomeratus*.

Difficulties relevants

a) Environmental education

Last year, the teachers had many activities. For example, sport championships, training programs for Bolivia's new education reform, and other religious and patriotic cultural activities. These reduced the time to plan workshops and it reduced the time to teach the students. However, we made an agreement with another local organization "Proyecto de Alcantarillado y Manejo de Agua - PAMA" that also wanted to include in their planning curriculum the themes of the environment and management of potable water in the main village. Therefore, we worked together to carry out the workshops with the teachers, the content being curriculum planning for on environmental conservation (including both perspectives). Although PAMA already had a guide for teachers (provided by the Ministry of Environment and Water of Bolivia), we preferred to design a guide with various topics about local problems of the forests of Independencia, prioritized by the teachers.

b) Facilitation local agreements to the community-based forest management

The community of Pajchanti had new conflicts and problems with use of the *Podocarpus* forest. When we did the interviews, they spoke to us about their problems openly, but some did not tell us the main problems of the forest, due to fear of accusing other powerful members of the community. During the workshops, they debated various topics, but the key problems were not being touched. Then, we started to introduce problematic themes respecting the anonymity of the community members in the interviews (informants) and to think of new norms and arrangements to manage the forest. For example, some members of Pajchanti did cut the forest of *P. glomeratus* outside of the limits of the community, and others did not like this, but nobody made the accusation until we spoke of the problem at the meeting. So, the interviews were very important to get to know the social and ecological situations of each community better, and to treat relevant problems in communities. To speak about identified polemic topics at the meetings caused a loss of confidence with some members.

The communities have some problems for their regulations to work effectively. The main causes were: a) Sometimes they do not accuse powerful members of wrong activities, due to fear or embarrassment. We treated this problem and consequences in the compliance of the norms, but this not will be sufficient; b) They did not always observe changes in the forest in a similar manner, and good decisions were not always made because of this. We wanted to carry out a forest census to improve the perception of abundance of trees in the forest, but they did not accept the idea, c) The norms are not valued in the same manner by all the members. Most of the people abide by the regulations, but a minority do not. This causes problems in the effectiveness of the norms. It is clear that our participation among them facilitated motivation, but we are worried, because who will make this work in the future, if they will not overcome these organizational problems. However, we observed an improved learning about the forest in these last years.

The municipal government had interest in participating in workshops to debate the problems of the forest at the municipal level at the start of the project. However, it was difficult to program days and hours to carry out the workshops. During this project, three professionals were changed. Sometimes not all participants came to the meeting because they were out at the communities. The poor organization of the municipal government did not help either. We also tried having these workshops together with the NGO FUPAGEMA, but the problem was the same. After having the workshops, the follow-up was not taken seriously, in order to modify the organizational structure and the internal rules and functions to improve the work in communities with forests. The reasons for this situation were the poor prioritization of the native forests, few capable staff managing the forest, and the uncertainty that they would continue in the same post. Together with other organizations, we participated in some meetings with the favourite candidate for the municipal government, with the objective of initiating the proposal to reorganize the structure and functions of the "Department of Natural Resources and Environment" of the municipal government. These ideas were included in the municipal plan (2015 - 2019). Currently, this political party won the elections. We have a window open to work with them in the future. Maybe the future will hold the most important to work, with a perspective more political than technical, if we want influence in the municipal policies.

c) Recuperation of the forest

In the nursery, the biggest problem was the harvest of seedlings and vegetative material of both species, because there was poor regeneration in the forest. Later, the attack of *Peronospora* (September to December) killed many plants, but we achieved to control it with care and fungicides (Fig. 6). In addition, there was a problem with the slow growth of *Podocarpus* plants. These problems caused the delay of the plantations in the communities. Because of this, the reforestation took place in February and March of this year. The leaders of Fupagema were motivated to produce the native plants, but the people working in the nursery were not as capable to produce the plants with special care. Therefore, the volunteers had to provide more support to produce and look after the plants, reducing time to work in others objectives of the project. During the plantations some farmers of the communities did not following instructions for the plantation, as such the plantation near of shrubs as mechanism to facilitate the survival and growth of target trees, but our participation during plantations helped to monitoring and carried out corrections.

Fig. 6. Attack of Peronospora sp in *P. lanata* seedling in nursery

Outcomes

a) Environmental education

For first time, we were able to include a proposal of planning curriculum for environmental education, together with the teachers. The environmental education guides included the knowledge of organizations that have worked for many years in the municipality about the extinction of species, distribution and ecology of native forests, causes of the degradation and overexploitation of the soil, the forest, and species such as the *Podocarpus* and *Polylepis* trees. In addition, we provide fun learning methodologies to teach to children and youth of rural areas. Link: https://sites.google.com/site/conservacionbosquesneblina/guia-educacion-ambiental-para-profesores-de-independencia-ayopaya-cochabamba

Then we carried out interviews with the people of the municipality (60 people), revealing that 30% of them, approximately 8000 children, teenagers and adults of the municipality, heard our 9 radio programs produced about conservation of the cloud forest, forestation, and local experiences in forest management. We received good comments about the programs. Analysing their opinions, the programs did not influenced about the participation of the people on municipal policies for forest management, but we learned that farmers could give opinions more conservationists in communal meetings, in order to reinforce the forest management.

b) Local arrangements

We worked together with the communities (Pajchanti and Salviani) to evaluate if the majority of their norms and arrangements to forest use are been fulfilled. The burning of the forest and grassland were reduced to zero in the last years, *P. racemosa* have been protected, and no one cuts down within the communities, and the commercial use of the wood of *Podocarpus* and other native trees were forbidden.

In Pajchanti, the rate of harvest of *P. glomeratus* has been reduced; no one has cut one tree without a communal authorization, among other norms. Their new updated norms with the

project look to regulate the cutting and burning of the forest inside and outside of the community, also optimize the quantity of wood harvested depending requirements of each family, reduce the waste of wood and cut trees of different areas for reducing the impact in a same area. These regulations will help the internal demand of the community of Pajchanti do not affect so much at forest (Fig. 7).

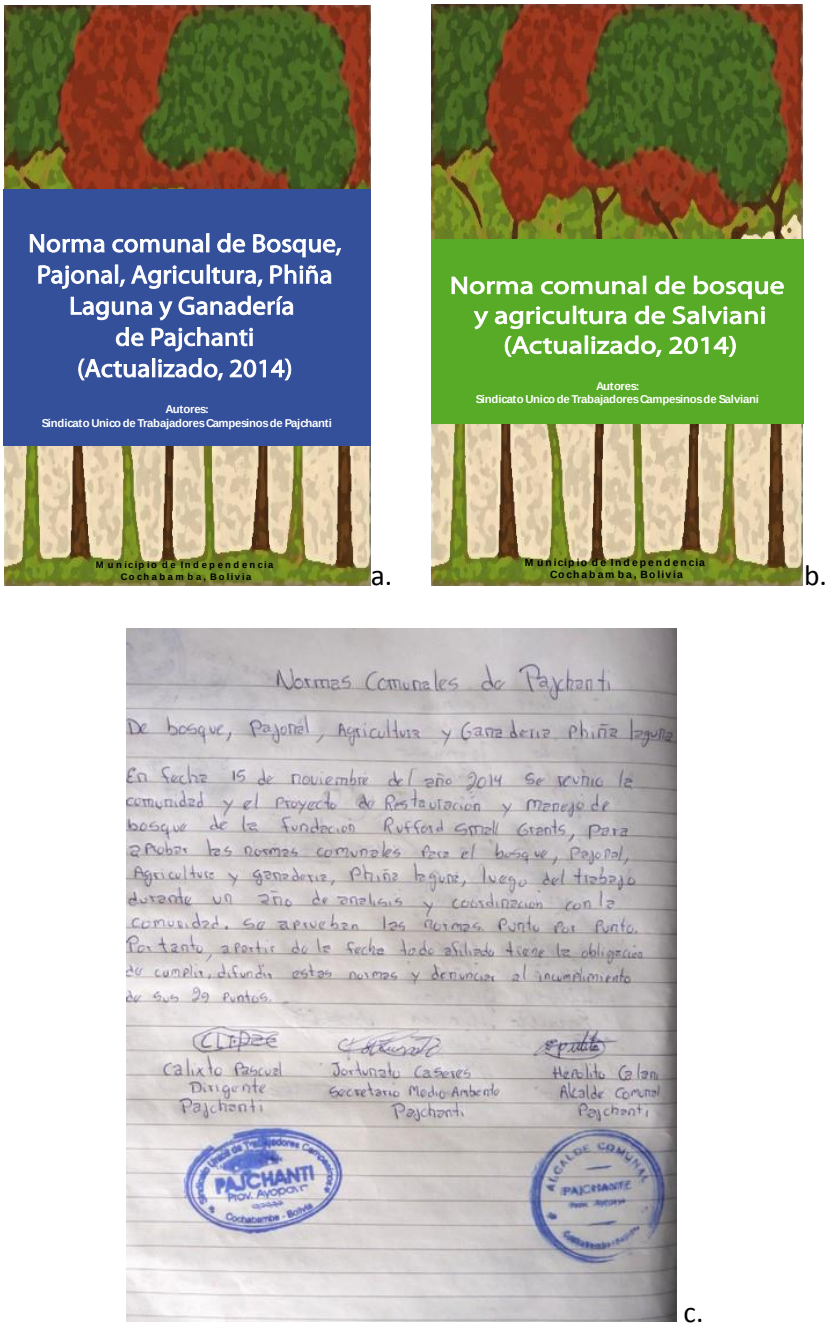

Fig. 7. Norms updated to regulate the forest use of the communities Pajchanti (a) and Salviani (b). These norms were approved with participation of all the members of communities and they signed minutes.

In Salviani, the norms have reduced the quantity of cattle inside the forest, the burning of old forest and the expansion of plantation of such exotics trees as *Eucaliptus globulus* and *Pinus radiata*. The protected area created and extend inside the community was respected, too. The

new norms updated with the project look to reinforce the organizational systems in order to facilitate the accusation and sanctions of people of the community and neighbours that not comply with the norm, and establish explicit functions for members and authorities of the community (Fig. 7). The norms of Pajchanti and Salviani are available on line: https://sites.google.com/site/conservacionbosquesneblina/relacion-bosque---comunidad/experiencia-de-normas-comunales-bosque-agricultura-pajchanti-y-salviani

In the community of Palermo, the situation was different. They had some norms to use the forest, and these were valued and reinforced with others that look to protect the *Polylepis* forest in a similar manner as that in Salviani and Pajchanti.

We learned that new problems for the forest can arise and that the communities should learn to adapt their rules and decisions without outside help, and alternatively, have links with other local organizations that could mediate conflicts and monitor the behaviour of them with their forest and norms (Our participation with the projects Rufford contributed in them). Pajchanti and Salviani put up signs to inform the sanctions for the burning, felling, hunting or littering in the forest. This will avoid the farmers and students from other communities commit these offenses.

Activities of unsuitable use of the forest by some families with power inside the community, and even some schools, were stopped after much discussion and debate with them. We also supported the print of the regulations for all members and the production of radio programs to spread the new updated and extended regulations.

We have understood that the work among the local government, NGOs and local communities to conserve the forest is very important for them, but there exist organizational limitations among the organizations. The most important were: The municipal government changed personnel very frequently, and they did not have a great understanding of the problems of communities for use of the forest (Control and monitoring of the forest were rarely carried out, and personnel did not know the local rules to forest use). Also, they had a lot time prioritized for agricultural practices, and little time for the forest. The communities still do not have enough trust in the NGO and municipal government to talk about their internal problems for forest use, and they know that the rules do not always work because not all people follow them. Therefore, sometimes they need the help of others to improve their rules and apply sanctions. Last, the NGOs work mostly in their specific projects, apart from the municipal context. The coordination and assistance to communities is not always a part of their projects.

c) Forest recuperation

Previous forestations were evaluated "in situ". We have a high mortality of plants, among 60 to 70% of plants. Conditions are optimal for altitude, nutrients, and microhabitats, and this seems to be the explanation for this result (a statistical analysis was carried out with previous experiments). The new forestations were carried out together with the experiments that will monitor the survival and growth of plants in different microhabitats, nutrients and type of reproductive material (vegetative or generative), considering previous results. The data will be taken the next years and we will expect better results. Our have some publications about propagation of *P. glomeratus* and *P. lanata* in nursery in our web: https://sites.google.com/site/conservacionbosquesneblina/propagacion-de-arboles-nativos.
Also we have a scientific article published about survival and growth of *P. lanata* in

plantations. http://www.scielo.org.bo/scielo.php?script=sci_arttext&pid=S1605-25282015000100002&lng=en&nrm=iso and other in preparation.

The analysis of data suggests that the principal problems of survival and growth of plants were the altitude, microhabitats and nutrients. The new experiments and reforestation implemented this year considered these previous results. We hope that the new reforestation and experiments will have better results. Apart from that, we can assess how many can affect the nutrients and conditions of microhabitats in the reforestation

Involvement of local communities

Until now, all of our principal results were made with the beneficiaries. The teachers participated in curriculum planning and fairs with us. The environmental education guides and bibliographic material was donated to the three schools by those with whom we worked. The communities of Pajchanti, Salviani, and a little less Palermo (this was the new community that we recently started to work with), participated with the interviews, by debating problems, and by approving the evaluations and new rules or adaptations for forest use. Therefore, I think that the rules and experience will stay in the communities. Also, we distributed sufficient copies of the updated norms for each person of the communities and other neighbours, as well as banners with all the norms for their meeting house and signs inside each community (Fig. 8). The work with the local radio was carried out for all the people of Independencia and we confirmed that at least 30% of all the population of the municipality listened the programs. The reforestations were carried out with communities, they know their location and the experiments, and will observe the differences among treatments, too.

Fig. 8. Sign in the community of Salviani put in strategic places.