

Enhancing sustainable management of natural resources through a competition-based approach

A closer look at the Pachamama Raymi approach and its impact in the Ccarhuayo district in the southern Peruvian Andes



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Abstract

Land degradation forms an important constraint for rural development in developing countries. It is frequently induced by poor management of natural resources and traps rural communities in vicious cycles of degrading land and poverty. Changing farmers' management strategies towards more sustainable and profitable management strategies in order to stop land degradation has proven to be very difficult. In this context, this paper presents the Pachamama Raymi approach as applied by the NGO Pachamama Raymi in the southern Peruvian Andes. Central to the Pachamama Raymi approach are competitions with cash prizes, horizontal transfers of knowledge, the integration of environmental concerns in socio-economic contexts to contribute to solving farmers' primary needs, and the close cooperation with local governments. To evaluate the impacts of this approach, a case study was conducted in the Ccarhuayo district. Data was gathered through 61 interviews with farmers, PMR staff, municipality staff, and other people of relevance. Approximately 75% of the people in Ccarhuayo actively participated in the Pachamama Raymi project and these participants showed significant changes regarding their natural resource management. These changes were largely sustained and replicated 1.5 years after project ending. Participants showed an important shift in focus and time dedication from low- to higher-income generating activities and they were found to be more positive about their future perspectives. Concluding, the case-study results indicate that the Pachamama Raymi approach holds the potential to enhance farmer's natural resource management on large scales and within a short period of time. Although more research is needed, first indications show that the Pachamama Raymi approach could serve as an interesting example in the worldwide search for effective approaches to tackle the problem of land degradation and poverty in rural communities.

Key words: Pachamama Raymi, participatory approach, natural resource management, competitions, impact, Peruvian Andes

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1. Introduction

Land degradation forms a major constraint for rural development in developing countries (Posthumus, 2005). It is frequently induced by inadequate management of natural resources, triggered by the interplay of environmental, economic and social factors (Pulido and Bocco, 2014; Bestelmeyer et al, 2015). Changing farmers' management strategies to stop land degradation has proven to be very difficult, as, by nature, people are resistant to change and instead prefer to stick to habitual behaviors and routines (Hon et al, 2014; Ford et al, 2008). Additionally, rural poverty and land degradation are often engaged in positive feedbacks, trapping rural communities in vicious circles which are hard to break (Easdale and Domptail, 2013).

Conventional approaches addressing the problem of land degradation were top-down and technology-centered (Davis, 2008), with specialists transferring (technological) innovations to farmers (Larsen and Lilleør, 2014). Farmers' needs were not addressed (Kiptot and Franzel, 2013) and economic and institutional contexts were barely taken into account. Limitations of these approaches have widely been recognized (Röling and van de Fliert, 1994; Larsen and Lilleør, 2014; Pulido and Bocco, 2014) and as a response, more bottom-up, integrated, participatory and farmer centered types of approaches were developed (Kiptot and Franzel, 2013). The leading paradigm shifted from transferring technologies to influencing farmers' daily decision making processes by facilitating learning paths and farmer empowerment (Davis, 2008). Currently, land degradation has been addressed at different levels and through different types of participatory approaches. The actual adoption of sustainable natural resource management practices however remains limited (Schwilch et al, 2012). Successes have been achieved, but usually on small scales. There is still a need for approaches and accompanying methodologies that achieve long-term impact on extensive scales in a short time (Kessler, 2007).

In this light, this paper presents the Pachamama Raymi approach. Pachamama Raymi means 'celebrating mother earth' in Quechua, a traditional Andean language. The approach is used by the equally named non-governmental organization (NGO) Pachamama Raymi which mainly works with rural communities in the southern Peruvian Andes. Here, extensive land degradation and declining soil productivity are common problems (Posthumus, 2005) and poverty is still wide-spread (Hellin and Hignan, 2005). Pachamama Raymi specifically aims to break the vicious cycle of land degradation and rural poverty by instructing and motivating farmers to implement more sustainable and profitable ways to manage their natural resources. The Pachamama Raymi approach is a trans-disciplinary approach, focusing on the environmental, economic and socio-political aspects of participants' livelihoods. Central to the approach are competitions as a tool for mobilization and motivation. The objective of this paper is to describe the Pachamama Raymi approach and to assess its impact on farmers' natural resource management strategies through a case study in the Ccarhuayo district.

This paper starts with a more extensive description of the Pachamama Raymi approach whereby its distinctiveness in relation to farmer-to-farmer extension approaches is also shortly discussed. Subsequently the Ccarhuayo district is introduced and the concepts and methods used for the case study are explained. Next, the case-study results are presented and discussed after which the final conclusion is presented.

2. Explaining the Pachamama Raymi approach

The NGO Pachamama Raymi (henceforth PMR) was established in 2008, though in prior years the approach as such had already been developed and applied in other projects in South America. The Pachamama Raymi approach is valid for all projects implemented by the NGO PMR. Specific project objectives differ (slightly) per project as every project area differs. The specific project objectives as applied in Ccarhuayo are discussed in the next chapter after the case-study background is described.

2.1 The Pachamama Raymi approach

Six-months lasting competitions on village level, with farmers competing against each other, and at district level, with villages as a whole competing against each other, form the core of the PMR approach. Competitions are used as a tool to mobilize and motivate participants to actively participate in the project and achieve quick results. Because participants compete on village and district level simultaneously, they are stimulated to improve their individual as well as their collective situation. Participating farmers and villages obtain points by achieving certain goals of a long list of options which is set up and distributed by PMR. They choose per competition, on the basis of their own dreams, needs and wishes, on which themes and specific objectives they want to work. With this, PMR aims at the implementation of coherent sets of innovations which correspond and contribute to solving individual farmers' needs and key problems such as poor living conditions and low income. After six months, progress is evaluated by village juries who are elected by participants themselves. The families and villages who performed best win considerable cash prizes which are awarded to them on festive prize award ceremonies. Subscribing for the competitions is easily accessible and cash prizes have proven to quickly draw people's attention, so by putting competitions central, large groups of farmers are reached in a relatively short time. Giving participants either money or materials during the competitions is almost completely avoided, so that all progress is paid with farmers' own resources, assuring feelings of ownership and stewardship. PMR aims at participation of minimally 60 percent of the total target population, a percentage which is amply met in nearly all projects.

PMR projects are carried out in poor rural communities, who are dependent on their natural resources for the production of food and the generation of (a part of) their income. Pachamama Raymi aims to stop land degradation and help these farmers overcome poverty by focusing on the implementation of more rational, sustainable and profitable ways to manage natural resources. To achieve impact and change farmer behavior in only three years' time, the objectives of the project related to environmental concerns are embedded in socially and economically attractive activities. The aim to integrate socio-economic principles with environmental concerns forms a core principle of the PMR approach. Furthermore, although not the focus of this paper, PMR effectively incorporates themes related to hygiene, housing and health in the competitions, in order to improve participants' living conditions on all most important aspects.

The PMR approach promotes transferring knowledge through horizontal frameworks. In practice this means that virtually all field staffs are farmers themselves, who have proven to be practical experts regarding (some aspects of) natural resource management, who speak the local language Quechua as their mother tongue and are not or barely academically trained. The latter is not necessary because most to be transferred knowledge is practical knowledge, which comes with experience. PMR believes that transfer of knowledge is more effective when farmers and PMR staff can easily relate to

each other. This is also reflected in the sober working conditions of the staff; PMR staff move by foot or motorcycle and do not have cars at their disposal, they work for three weeks straight (Monday-Sunday) followed by a one-week break, during work days they sleep in the villages where they work, and lastly, there are no set working hours but instead, staff is paid and assessed on the basis of achieved results. These working conditions strengthen the relation between PMR staff and participating farmers, which in its turn facilitates the transfer of knowledge, as was acknowledged by PMR staff and farmers in this study.

For motivation it is essential to be aware of the fact that problems can be solved and that the future can be better (Kessler et al, 2015). Therefore horizontal knowledge transfers are further facilitated through exchange excursions. During these excursions, farmers visit peers who used to find themselves in similar situations, but found sustainable ways to overcome poverty and improve their quality of living. Sometimes these peers have previously worked with PMR, sometimes they found interesting ways to overcome poverty themselves or through other organizations. Important is that visiting farmers easily recognize themselves in these peers and start believing in their own capability to realize similar changes. It is thus not only knowledge that is transferred through these exchange excursions, but motivation and positive future expectations as well.

A last cornerstone of the PMR approach is that all PMR projects are executed in close cooperation with local governments. At the start of every project, PMR signs an agreement with the local government to decide on sharing costs and tasks, and specify and secure further cooperation. By involving local governments in the project, PMR aims to create an enabling institutional context which lasts longer than the project alone. In the competitions, participants are encouraged to increase their levels of organization through the establishment of producer associations or village cooperatives, with overarching boards on district level. By involving local governments in the project set up, stable and lasting collaborations between newly set up boards (representing the interests of their village or producer group) and local governments can be established.

PMR projects (optimally) last three years in which several competitions are organized; one competition is quickly followed by the next one. After three years, PMR retreats from the area and farmers and their local government are expected to be able to continue on the same path without further incentives or help.

2.2 Distinctiveness of the Pachamama Raymi approach

It is easy to connect certain aspects of the PMR approach to farmer-to-farmer extension approaches such as the Farmer Field Schools approach (Jørs et al, 2014), the Volunteer Farmer Trainer Approach (Kiptot and Franzel, 2014) or the PIP approach (Kessler et al, 2015). However, although similarities can be found, the PMR approach clearly differs from these approaches on several grounds. First, PMR uses six-months lasting competitions as a means to motivate participants to achieve quick results. Hereby, PMR aims for constant and direct participation of the whole target group (with a minimum of 60%). Typical farmer-to-farmer extension approaches focus on training a few key farmers by external agents, after which these trained farmers are expected to share their knowledge and skills with other farmers.

Also, through the PMR approach, individual and collective action are simultaneously stimulated during the whole project, by organizing competitions on village and district level. Most farmer-to-

farmer extension approaches, like the Volunteer Farmer Trainer approach as applied in Kenya (Kiptot and Franzel, 2014) or the Farmer Field Schools approach as applied in Bolivia (Jørs et al, 2014) do not specifically encourage collective action. The PIP approach as applied in Burundi (Kessler et al, 2015) does encourage collective action, but mainly in later stages of the project. Furthermore, the PMR approach is designed for close cooperation with local governments, whereby local government bodies also contribute to parts of the costs, provide staff and are engaged in decisions to be made during the project. The local government is not only 'involved' in the project, but is also made partly responsible for a successful completion of the project. The importance of an enabling institutional context for sustainability of impacts is mentioned in most recent papers about rural development. However, papers describing other participatory approaches with a profound form of institutional involvement like in the PMR approach were not found.

3. Empirical research in the Ccarhuayo district

To evaluate the actual effects of the PMR approach described hereinbefore in chapter 2.1, a case study was done. The core of this paper explores the impact of the PMR approach as applied in the Ccarhuayo district. This chapter introduces the background of the district whereby the key project objectives of PMR in Ccarhuayo are given, and describes the concepts and methods used to perform the case study.

3.1 Setting the scene

The Ccarhuayo district lies approximately 120 km east of Cusco in the Quispicanchi province, which is part of the Cusco region in Peru (see Figure 1). The district contains 13 villages with in total 480 families. In 2013 it was classified as the fourth (out of 108) poorest district of the Cusco region (INEI, 2015). There is no (stable) satellite phone connection and not all households have access to electricity. People, especially women, live in seclusion from the outside world.

Figure 1 – Overview study area location



Possibilities for agricultural production are limited by the thin soils on hard rock material (*leptosol soils*) (Ministerio de Agricultura y Riego de Peru, 2015), elevation ranges between approximately 3000m and 5000m, sloping land and a lack of water. Instead, the land is most suitable for extensive livestock farming and forests (Raboin and Posner, 2012). Herding is an ancient tradition for Ccarhuayan people. Livestock species important to rural household's livelihoods include sheep, alpacas and guinea-pigs, and to a lesser extent cows, llamas, chicken and pigs. Households depend on their livestock for sources of income, protein, fertilizer and savings/insurance. Compared to

agricultural production, animal husbandry is more market oriented and provides the largest part of the on-farm income (Kristjanson, 2007; Postigo, 2008). However, years of free-roaming have left large parts of the land in Ccarhuayo unproductive and degraded, making it harder to feed the animals and maintain healthy and large stocks. Currently, for most families only a small part of the total family income is generated by on-farm activities. Usually men have side-jobs during (parts of) the year in construction or mining and this is where relatively most money is made.

Figure 2 – Overview locations of villages within the Ccarhuayo district



PMR worked in the Ccarhuayo district for three years, during 2011 until 2014. On average, 75% of district inhabitants participated in the PMR project. Because the land in Ccarhuayo is most suitable for forests and extensive livestock farming, implementing a more sustainable and profitable way to manage natural resources in Ccarhuayo was done by PMR through stimulating 1) the plantation of pine trees, 2) a change in animal types and stock, and 3) feeding these animals by cultivated and irrigated fodder instead of natural grasslands. As possibilities for agricultural production are very limited, they were not focused on by PMR.

3.2 Concepts and methods

Due to difficult access and limited time available, only two villages from the Ccarhuayo district were (non-randomly) selected for an in-depth study; Ccasapata and Tayancani (see Figure 2 for locations). Whilst focusing on these two villages, the other villages in the district were all visited at least once. Other districts were also visited, to observe the PMR approach while being applied or to observe natural resource management practices in villages where PMR did not work, or left more than two years ago.

Table 1 – Basic information study sites

Ccasapata	Tayancani
26 families	34 families
Village centre with 2 annexes	Houses spread, no village center
3800-4200 above msl	3400-3800 above msl
1465 hectares	3200 hectares

Data was gathered during four months of field work (August – November 2015), using a mix of different research methods. The main methods used were semi-structured interviews (total 61) and observations, complemented with data gathered by PMR during the project and insights obtained from literature research. Interviews were held with farmers in- and outside the Ccarhuayo district, PMR staff, municipality staff and some relevant others. In Ccasapata 13 interviews were conducted (50 percent of the population), and in Tayancani 14 interviews were conducted (41 percent of the population). The absence of a baseline study makes that comparisons between ‘before’ and ‘after’ depend on answers given by farmers today.

On the basis of the data collected in this case-study, the impact of the PMR approach on farmers’ natural resource management strategies was evaluated. This paper leaves project objectives and impacts regarding hygiene, housing and health out of consideration. The natural resources most focused on are land, vegetation and animal life. Impact refers to all effects produced by the PMR project, which could be direct or indirect, intended or unintended and can relate to economic, sociocultural, institutional, environmental, technological or other aspects (Chianca, 2008). To study the impact of PMR, and thus the extent to which new natural resource management strategies were adopted, it is important to distinguish certain stages of the adoption process (de Graaff et al, 2008). Adoption starts with the acceptance phase which generally includes the awareness, evaluation and trial stages and which eventually leads to the decision to invest (either time, resources or money) in a certain practice. This phase is followed by the actual adoption phase, whereby efforts or investments to implement new practices are actually made. Last is the phase of continued use, whereby measures or practices are fully integrated in the farming system, they are maintained over many years and new ones are replicated at other locations. This phase refers to farmers who are intrinsically motivated to implement the new practice(s). Intrinsic motivation refers to people who are moved to do something because it is inherently interesting, challenging or enjoyable, rather than because of external pressures or rewards (Deci and Ryan, 2000). Within this study, we specifically looked for evidence and indications for this last phase of adoption and thus long-term impacts.

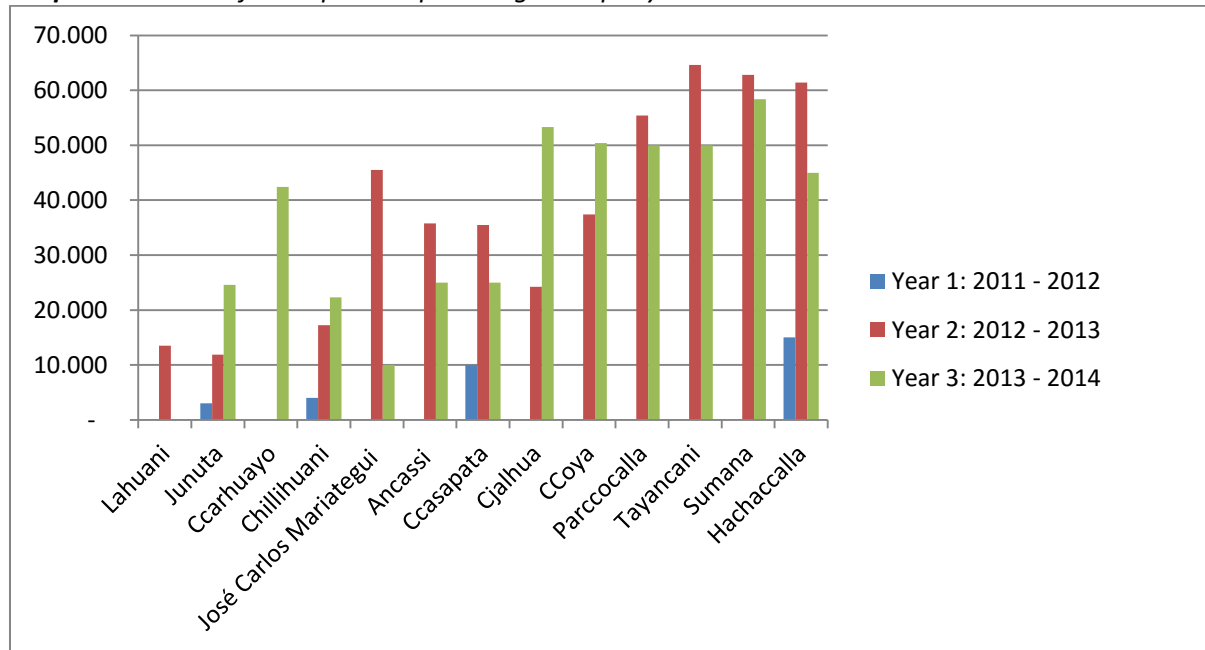
4. Results

This chapter presents the results of the case-study in Ccarhuayo. Impacts are described according to the three key project objectives regarding natural resource management in Ccarhuayo; planting pine trees, changing animal stocks and types, and cultivating fodder and improving grazing management.

4.1 Planting pine trees

When the PMR project in the district of Ccarhuayo started in 2011, few families had small forest (mainly eucalyptus) plantations, but trees were not planted on a yearly basis. In the first year of the PMR project, a tree nursery was set up in Ccarhuayo town and since the start of the project, trees can be picked up for free by all inhabitants of the district so that they need to confront ‘only’ transport costs and labor to plant trees. Graph 1 shows the number of pine trees planted per year and per village during the project. Villages were ordered from left to right according to the total number of trees planted. Eucalyptus trees are excluded from the graph as they only make up 4 percent of the total number of trees. The planting season depends on the rainy season, which peaks in December and January, so therefore years are indicated as, for example, 2011 - 2012. The numbers of trees as showed in Graph 1 refer both to trees on individual and communal property.

Graph 1- Number of trees planted per village and per year



Graph 1 shows clear divergent outcomes per planting season. In total, 32.000 trees were planted in year 1, 480.343 in year 2 and 478.425 in year 3. As the tree nursery was established in the year 2011, it can be reasoned that fewest trees were produced and planted during this year. The number of trees produced and planted sharply increased in the second year and stayed almost equal during the third year. In total, from 2011 till 2014, 1.001.768 trees were planted. After the project ended in 2014, PMR stopped keeping up specific planting data. However, observations and interviews done for this study show that people continued planting trees in the planting season 2014-2015 and that the majority was planning to plant in 2015-2016. During fieldwork for this study, the tree nursery in Ccarhuayo town was still fully operational; in November 2015 it held 700.000 *pinus radiata*, 120.000 *eucalyptus* and 30.000 native tree species.

Differences between villages can partly be explained on the basis of transport as a limiting factor. It can be seen that villages further from the main tree nursery in Ccarhuayo town (like Lahuani and Junuta) planted relatively small numbers of trees, and that villages closer by the tree nursery (like Parccocalla, Tayancani and Sumana) planted a larger numbers of trees (see Figure 2 in chapter 3.1 for locations of villages). Another limiting factor for planting trees might be the amount of land a village owns; although villagers from Ccarhuayo town have easiest access to the tree nursery and need least transport, communal and individual land sizes are insufficient to plant large numbers of trees. Interviews in Tayancani and Ccasapata confirmed that the enthusiasm to plant trees partly depends on the size of individual lands, because people prefer to plant trees on individual lands instead of communal lands. Trees planted on communal property officially belong to the community and revenues will be shared. In Ccasapata individual lands are relatively small, forcing people to plant on communal lands once their individual property is 'full'. In Tayancani individual lands are relatively large and were never mentioned to be (almost) full of trees. In this study, families in Ccasapata mentioned to have planted 2655 trees on average, while in Tayancani the average was 6951, with outliers of up to 19.000 trees per family.

PMR staff estimated that 80 percent of the trees planted in Ccarhuayo survived the first 5 years. The main threat to the survival of the trees is damage due to free grazing of sheep. This problem was tackled by PMR through the establishment of forestry guards in every village, whose main task is to create a context in which young trees are protected from sheep. The guards created rules to not allow sheep to enter areas where young trees are planted and to establish fines for damaging trees. The height and form of the fines differs per village. For example, in Ccasapata villagers are obliged to pay 30 soles (about USD 10) per tree while in Tayancani people have to plant two trees for every tree that is damaged. On district level, the village forestry guards are represented by an overarching board that holds direct contact with the economic development department (ODEL) of the Ccarhuayo municipality, to plan and coordinate all forestry activities in the district.

When asked about the most important reasons for planting trees, most farmers referred to economic benefits. Environmental benefits were hardly mentioned. On the long term, planting trees allows farmers to build up a pension because after approximately twenty years, trees can be harvested and the wood can be sold. On the short term pine trees also generate income; as afforestation generally increases species richness of fungi (Eggertsson, Nygaard and Skovsgaard, 2008) and one type of fungi that emerges is edible and can be sold for relatively good prices. For many, this generates a new and additional form of income that does not require any additional input.

4.2 Changing animal stocks and types

The four most important actions, regarding a more sustainable and profitable use of animals, that were stimulated by PMR were 1) to sell their sheep, as they barely generate income and have strong negative effects on young trees and natural grasslands, 2) to increase the number of alpacas, as they generate more income and have no negative effects on young trees, and less negative effects on natural grasslands, 3) to increase the number of guinea-pigs, as they generate more income, the income comes in more frequent and breeding them is more resistant to seasonal fluctuations and, 4) to improve the quality of all animals, in order to increase the quality and value of animal products.

Table 2 was created with data obtained in this study and although both villages differ in absolute numbers, it shows that trends are clear and similar; a sharp decrease was found in the number of sheep held per family. Contrasting, the number of alpacas and guinea-pigs per family increased. No data from PMR’s database could be found to see how these numbers have changed in the other villages of the district, however, there are no indications that trends differ. Although no quantitative data was collected regarding changes in the relative share of ‘improved’ animals in family’s herds, in the interviews farmers mentioned that improving animals was a topic of main concern.

Table 2 - Average number of animals per family per village

Ccasapata	Sheep	Alpacas	Guinea-pigs
Before PMR	56	11	16
After PMR	7	18	24
<i>Relative difference</i>	<i>88% reduction</i>	<i>64% increase</i>	<i>50% increase</i>

Tayancani	Sheep	Alpacas	Guinea-pigs
Before PMR	52	17	25
After PMR	14	21	141
<i>Relative difference</i>	<i>73% reduction</i>	<i>24% increase</i>	<i>464% increase</i>

The sharp decrease in the number of sheep, respectively 88 percent and 73 percent in the two villages (see Table 2), is partly connected to the large number of trees planted. The rule and fine systems that were created by the forestry guards make it more difficult to keep sheep. Less grassland is available for sheep to graze on which forced many sheep owners to sell (some of) their sheep due to a lack of feed. Second, farmers gained awareness of the fact that herding sheep is not economically profitable. Both sheep meat and wool generate relatively low returns while feeding them takes long herding days in the mountains. Farmers indicated that before the PMR project started, most did not think about the profitability of herding sheep. It was a tradition of people's parents and was copied. Also, farmers acknowledged not being aware of alternatives. Contrary, sheep were now frequently referred to as a 'plague' for the environment and income; an interesting switch of perception.

Many farmers replaced their sheep for alpacas and the number of alpacas increased with respectively 64 percent and 24 percent in the two villages (see Table 2). Alpaca wool and meat generates more income (in comparison to sheep) and alpacas do not eat young trees and can therefore graze in between the trees (unlike sheep). Some also mentioned the reason that (in comparison to sheep) alpacas graze more 'quietly' which allows shepherds to do other tasks like weaving while herding them.

Guinea-pigs are a traditional part of meals in Peru and demand for guinea-pig meat is high, from both in- and outside the district. Guinea-pigs can be bred and sold within three months' time, so a return on investments is quick. Additionally, when breeding guinea-pigs, it is relatively easy to sell the majority before the peak of the dry season (because there will not be sufficient fodder to feed them), and to intensify breeding when sufficient grass is available. This makes that guinea-pig breeding is more flexible and resistant towards seasonal fluctuations. Although most families have always had a few guinea-pigs for self-consumption, there were no guinea-pig stables in the district and people did not know how to breed guinea-pigs professionally before the PMR project started. When the PMR project ended, there were 76 guinea-pig stables in 9 villages (Zeisser and Tupayachi Mar, 2014). This corresponds to 16% of all families in the district. Table 2 shows that the number of guinea-pigs in both Ccasapata and Tayancani increased with respectively 50 percent and 464 percent. The tremendous increase of guinea-pigs in Tayancani can be explained by the fact Tayancani has easy access to the interoceanic-highway, which passes along the eastern border of the Ccarhuayo district. Guinea-pig meat can thus easily be sold to small restaurants along the highway. A few farmers in Tayancani decided to completely specialize in guinea-pig farming and these farmers have up to 600 guinea-pigs; stables were extended to expand farms to up to 1000 guinea-pigs. Others farmers in Tayancani referred to these large guinea-pig farmers as examples of what they would like to achieve some day too.

The organization level of animal producers was increased by setting up associations for alpaca owners, cow owners and guinea-pig owners. These associations function as buying/selling cooperatives and interest defense groups. Like the forestry guards, every association has an overarching board on district level that holds direct contacts with the economic development department (ODEL) of the municipality, to defend the interests of their associations on district level. An interesting result of this is that in 2012, the municipality set up a program to buy high quality reproductive alpacas, which were given to the alpaca producer associations to help farmers improve their herds.

4.3 Cultivating fodder and improving grazing management

On the basis of a more sustainable and profitable way to manage land lays the transition from natural grasses to irrigated and cultivated fodder (a mix of clover and grasses) as the main source of feed for animals. The cultivation of clover and grasses improves soil productivity of impoverished soils and allows for more productive agriculture after rotation (Sears et al, 1965). Second, it decreases the grazing pressure on natural grasslands and allows natural grasses to rehabilitate. Furthermore, this transition contributes to improving productivity of livestock (Bryant et al, 1989; Van Staun, 2006) and it allows farmers to centralize their working area and stay at home during the day. This is more comfortable in comparison to herding animals in the mountains, but also allows farmers to pick up other activities around the house, like taking care of the children or tidying up.

In Ccarhuayo, the cultivation of fodder is mainly limited by a lack of water for irrigation. In the early 2000's the municipality invested in the construction of irrigation systems and the majority of farmers have access to water via irrigation infrastructures, although it is usually limited to a few days per week. During the dry season, water availability can completely disappear. Several farmers confirmed that fodder was not cultivated before PMR's project started, neither in Ccasapata nor in Tayancani. There was no know-how and seeds were hardly available. During the PMR project, the demand for cultivated fodder increased in connection to the increasing numbers of guinea-pigs and improved alpacas and cows. Guinea-pigs mainly eat cultivated grass, mostly complemented with other types of feed. Improved alpacas and cows were mentioned to be more 'picky' as they mostly eat cultivated fodder instead of natural grasses. It was confirmed by the majority of farmers in both Ccasapata and Tayancani that they started cultivating fodder, and that the area of cultivated fodder still increases every year. Results could not be quantified, because farmers appeared being unable to mention or guess their current surface of land for the cultivation of fodder. Additional methods, other than observations, to measure the current surface of land for the cultivation fodder, were not available. However, the fact that no fodder was cultivated before the PMR project started, and the tremendous increase in the number of guinea-pigs confirms that the surface for the cultivation of fodder must have (sharply) increased.

Free roaming of animals was targeted in the following two ways. First, rotational grazing systems were introduced by explaining farmers about the gains of rotational grazing close to their homes. It was supported to paint rotational grazing strategies on the house. No quantitative data was collected on how many households adopted new grazing strategies. Villages were also encouraged to make communal arrangements about where to graze and when. All villages within the district made arrangements that animals can only graze in fields that belong to their own village. Borders cannot be crossed any longer. Additionally, rules were created to protect certain areas from grazing. In Tayancani farmers agreed to only enter a specific 10 hectares of grassland in the rainy period (December, January and February), so that the grasses can recover during the dry season. In Ccasapata most communal areas close to the village are currently full of young trees. Communal areas without trees are located further away. People are only allowed to enter these communal areas during the rainy season. This has resulted in an increased attention for (rotational) grazing on individual lands closer by. Individual lands are progressively (being) fenced.

5. Discussion

5.1 Effectiveness of the approach and sustainability of impacts

Results from the case-study in Ccarhuayo confirm that competitions are a successful way to reach large groups of people and motivate them to change. It was indicated by farmers that the short time horizon of the competitions, and the associated pressure to achieve results in six months, helped them to get started and gain results. Additionally, competitions make that the focus does not lie on participation, but rather on achieving results. Farmers were free to choose how they would like to achieve results and they were encouraged to experiment with new agricultural practices. Learning about these new agricultural practices was stimulated and facilitated in several ways, but all change was executed by participants themselves whereby the best farmers were rewarded with a cash prize.

The use of cash incentives has been debated in scientific literature (Current and Scherr, 1995; Sanders et al; 1999; De Graaff et al, 2008; Glover et al, 2013) as it is often feared that by using cash incentives, adoption is not based on intrinsic perceptions and motivation, but solely on the desire for money. After removal of the cash incentive, the adoption would then not be sustained. These critiques do not apply to this case as money and materials are not distributed during the competitions, which was also one of the main complaints of farmers in Ccarhuayo regarding the PMR project. Farmers pay with their own money and labor for all their investments, unsure of whether they will eventually receive a cash prize. Furthermore, investments are often higher than the highest possible cash prize. This stimulates critical thinking about whether the investment is worth making and contributes to feelings of stewardship. PMR believes that by giving cash prizes as rewards for performing best, farmers feel trusted, taken seriously and are treated as equals.

Literature about the use of competitions in rural development projects is scarce. In 2007, Kessler and de Graaff published an article specifically about the use of competitions for extension in a project in the Bolivian Andes. They concluded that despite the low extension costs and visible widespread impact of competitions, long-term sustainability could not be guaranteed as farmers easily became disillusioned and unmotivated after the competitions stopped. The catalyst effect of competitions was not yet strong enough. Competitions as applied in this Bolivian project focused on one or two measures and lasted for one or two months. The chosen measures usually did not generate economic benefits on the short-term. The PMR approach tries to overcome the previously mentioned problems by implementing many innovations at the same time in order to speed up change, whereby environmental measures promoting sustainability are always integrated in a context of income generating activities. Results of this case-study showed that 1.5 years after project ending farmers were still motivated to implement project goals.

Robson et al (2015) describe that, in general, if outcomes of a desired behavior change are perceived as being satisfying, the behavior is more likely to be repeated. In Ccarhuayo, most farmers appeared not being primarily interested in conserving their natural resources, but showed to be very interested practices that generate money. Taking into account that Ccarhuayo is classified as one of the poorest district of the Cusco region, the desire to increase income is considered completely understandable. This shows that addressing a complex problem like land degradation can only be successful if embedded in a trans-disciplinary approach that not only addresses the conservation of natural resources, but also focuses on farmers' economic and social contexts. Once again, this also shows why technology centered approaches did not achieve the desired results, as they did not contribute

to solving farmers' key needs of improving living conditions and earning an income. In this study, some farmers mentioned that even if they did not win a cash prize, they felt like they had won because they had managed to (for example) improve their houses, increase the number of guinea-pigs or plant trees; all activities that directly contributed to solving these households' primary needs. The outcomes of new practices and innovations introduced by PMR were thus perceived as being satisfying, whereby replication and maintenance of the new practices was encouraged. Some farmers who did not join the first competition mentioned the visible improvements of fellow villagers as their motivation to still join the subsequent competitions.

Another example of the use of competitions in a rural development context, are the competitions as applied in the PIP approach in Burundi (Kessler et al, 2015). Here, competitions were used as a scaling-up tool after a first group of farmers was extensively trained. Within the PIP approach, two competitions are organized during one year. During the first competition, the group of first trained farmers is encouraged to transfer knowledge to a 'second generation' of farmer trainers. In the following competition, the first and second generations of farmer trainers are expected to transfer their knowledge to all other interested farmers. Results of the PIP approach in Burundi show that during the second competition, 80% of the village population was covered (Kessler et al, 2015). In comparison, in Ccarhuayo approximately 75% of the district population joined the competitions during the whole project of three years. Participation alone however does not directly say something about final impact. As results of the PIP approach in Burundi have not been evaluated yet, is a further comparison between these two approaches not possible at this point.

A meta-analysis of literature about the effects of Farmer Field Schools explains that especially the evidence for (spontaneous) scaling-up of good practices through Farmer Field Schools remains uncertain (Waddington et al, 2014). Compelling is that in this study, farmers who did not join the PMR competitions did show to have adopted new management practices, and that spontaneous scaling-up did occur. Most prominent are cases of farmers who did not join PMR competitions, but still started breeding guinea-pigs professionally with the help of farmers who did join competitions. It was also confirmed that farmers who did not join the competitions, joined the established associations for alpacas, cows and guinea-pigs. Furthermore, farmers acknowledged that all village inhabitants had planted trees, without exception.

To sustain the new ways to manage natural resources on the long-term, it is important for the institutional context to be involved (Akhtar-Schuster et al, 2010). The institutional context refers to systems of rules, decision making procedures and programs that give rise to social practices (Gupta et al, 2010). In the case of Ccarhuayo, a stable institutional context was previously missing. In this region a new mayor is chosen every four years and when the mayor changes, all municipal staff changes. Interviewees mentioned that mayors tend to rebel against the previous one by deliberately changing many things that he/she has done. Setting up long term policies could be considered as rather difficult in such conditions. The created networks of organizations on village level with overarching boards on district level and the institutionalized forms of collaboration with the municipality now protect the district inhabitants to a certain extent from these rebelling mayors and help them to demand long-term support on topics that they consider important. A closer and more direct connection between villages and the municipality was created, which led to a more enabling institutional context. This contributes to the sustainability of impacts found.

A lasting and enabling institutional context was also set up by the establishment of fairs, which took over the role of competitions (regarding changing and improving animal stocks) after project ending. These fairs are festive occasions where food, drinks and animal shows are central. Animal owners come from afar to show their animals and the owners of the best and most beautiful animals win cash prizes and, maybe equally important, gain pride. At the time that fieldwork was being done, Ccarhuayo, Ancassi, Hachacalla, Ccasapata and Parcocalla all had their annual fairs. One farmer explained the importance of these fairs now 1.5 years after the PMR project ended; *“Fairs are very important. It is important to sell the animals. But also, we see the good and beautiful animals on the fair and then we want to have these animals as well. It works like the competition and there is a lot of mutual strife. It is very important for motivation. The prizes are rather high and for that reasons people like to join. They bring all their alpacas and guinea-pigs. Everything. Cows. Sheep. Everything. For that reason they are improving”* (Interview farmer Tayancani, 2015).

Results in Ccarhuayo show that farmers who participated in the PMR project not only implemented more sustainable and profitable ways to manage their natural resources, but have also changed their mindsets. Before PMR arrived, farm activities were not viewed as having the potential to significantly contribute to family income. During the competitions, a more entrepreneurial culture was created in which farmers actively started searching for income generating activities. Whereas farmers used to accept that all on-farm production was mainly for self-consumption, they acknowledged to have realized that small businesses can be started and money can be earned with on-farm activities. Farmers’ time dedication changed as focus shifted from low-income generating activities, such as having large herds of sheep and the cultivation of potatoes, to activities that generate more income, such as having cultivated fodder to raise guinea-pigs and planting trees.

Along the same line of entrepreneurial thinking, it was found that through series of small actions, land in Ccarhuayo is being ‘practically privatized’. Villagers are no longer allowed to cross village borders and are only allowed to graze on their own communal lands. Furthermore, although parts of the land were always formally entitled to certain families, land was not fenced and property rights were not enforced. No investments were made in the land, so there were no reasons to exclude others from using ‘your’ land for grazing. This however has changed in the last years. Individual lands are progressively fenced and used only by one family. Although officially it was already the case, individual lands are “practically” being privatized as well now. This privatization of land indicates that land is no longer perceived as an in-exhaustible common good. The importance of land privatization for economic growth and the reduction of poverty has been recognized for several decades now (Mitchell et al, 2008). With privatization of land, it becomes possible and more rational to invest in the land because future benefits of investments are secured (Leonard and Parker, 2016). Privatization thus further enables continued use of practices like planting trees, cultivating fodder or rotational grazing. General problems related to land privatization, such as land grabbing or fast changes in land ownership (Mitchell et al, 2008), are not relevant here because all the land officially belongs to the community. Sale of land must always be discussed in village assemblies and people from outside are not allowed to own parts of the land.

Finally, when farmers in Ccarhuayo were asked to explain how they used to think about the future before PMR’s project, basically all farmers answered that they did not think about the future. *“We did not have dreams because we did not know anything”* (Interview farmer Ccoya, 2015). When farmers were then asked to explain how they now think about the future, some of the answers were;

- *“We did not have dreams before, I just wanted more alpacas and more work. Then, when PMR arrived, my dreams became more clear and concrete”* (Farmer Ccasapata, 2015).
- *“We used to think that it was only possible to have sheep or cows, now we have a broader sight on all the possibilities we have”* (Farmer Ccasapata, 2015).
- *“Before, we also wanted to change but we only knew what our parents had taught us. That has changed. Now we know about guinea-pigs so our dreams are better now”* (Farmer Tayancani, 2015).
- *“We do not live like we used to anymore. We are looking at the others and we want to continue learning. We do not live like our grandfathers and grandmothers anymore”* (Farmer Tayancani, 2015).

These quotes indicate that the situation people find themselves in has changed and improved, that people have more knowledge about diverse possibilities to earn an income and that dreams for the future are more clear and concrete now. The belief in a better future and the willingness to invest in means to achieve this future are key for sustainable bottom-up rural development (Kessler, 2006). Only one year after project ending, the Ccarhuayo district was chosen as a location for exchange excursions. Farmers from other PMR projects now visit Ccarhuayo to see the improvements and accomplishments farmers have made. Farmers from Ccarhuayo now further pass on their knowledge, motivation and future vision to others.

5.2 (How) can these case-study results be generalized?

The best way to obtain an unbiased estimate of impact would be to do a completely randomized study on a large scale. However, due to limited time and money resources this was not possible and only one district was selected for an in-depth study. This brings up the scaling issue; how do results from the Ccarhuayo district say something about the impacts of the PMR approach in other settings?

The PMR project in Ccarhuayo was conducted in cooperation with a rather benevolent mayor. Also, the construction of the interoceanic-highway in 2007 (which passes the border of the Ccarhuayo district) increased the accessibility of the district enormously. Thereby, possibilities to market agricultural products have also increased. Furthermore, there are plenty of aspects to think of, that might have influenced the situation of people in the Ccarhuayo district beyond the influence of PMR. Such influences cannot be ruled out in a case-study. However, besides Ccarhuayo, the districts Ccapi, Colcha, Pilpinto, Pitumarca, Lares and Ocongate were also visited. No quantitative data was collected during these visits, however, the information obtained in these districts (through observations, informal conversations with farmers and some in-depth interviews) implicate that impacts of the Pachamama Raymi approach there do not fundamentally differ.

Relatively most interviews outside the Ccarhuayo district were conducted in Lahualahua, a village in the Ocongate district. Pachamama Raymi left the Ocongate district in 2011, and interviews were thus held approximately 4.5 years after project ending. Farmers in Lahualahua proved to have continued working on the main objectives that were introduced by PMR; only two (out of 46) families still herd sheep, most families cultivate fodder and mentioned that the area of cultivated fodder still increases every year, approximately 40 hectares of communal land are still protected from year-round grazing and this area is said to increase with approximately five hectares every year, new guinea-pig stables were being built at the time of fieldwork and observations and interviews proved that farmers continued planting trees on large scales after project ending.

More research is needed to further support evidence for the impact of the PMR approach on participants' natural resource management practices. However, results of this study, in and outside the Ccarhuayo district, show clear and similar trends of long-term impact on all key project objectives.

6. Conclusions

The objective of this paper was to describe the Pachamama Raymi approach and to assess its impact on farmers' natural resource management strategies through a case study in the Ccarhuayo district. Four key aspects of the Pachamama Raymi approach were identified; 1) the organization of competitions with cash prizes for the best performing farmers and villages, 2) stimulating horizontal transfers of knowledge, motivation and positive future expectations through peers, 3) integrating environmental concerns in socio-economic contexts to contribute to solving farmers primary needs and thereby secure the sustained use of new practices, and 4) the close cooperation with local governments during all stages of the project.

PMR specifically aimed to break the vicious cycle of poverty and land degradation in Ccarhuayo through stimulating farmers to plant trees, to encourage farmers to sell their sheep and increase the numbers of alpacas and guinea-pigs, and lastly, to boost the transition from natural grasses to cultivated fodder as the main source of animal feed. Approximately 75% of the people in Ccarhuayo participated in the competitions. Results of this case study indicate that participants showed significant changes on the three key project objectives. Over one million trees were planted during the PMR project, and more importantly, after project ending the tree nursery remained fully operational and people continued planting. The average number of sheep per family sharply decreased and average numbers of alpacas and guinea-pigs increased. In correlation with the increase of guinea-pigs and genetically improved animals, farmers started cultivating fodder. These practices were not only 'incorporated' in existing livelihoods, but form a completely new basis on which livelihoods are being built. Participants showed an important shift in focus and time dedication from low income generating activities to higher income generating activities. Participants were also found to be more positive about their future perspectives.

Given the urgency of land degradation problems, scaling up sustainable ways to manage natural resources, to stop or even reverse land degradation, is highly necessary. Although more research is needed, this study indicates that the Pachamama Raymi approach holds the potential to enhance farmers' natural resource management systems on large scales and within a short period of time. The methodology allows substantial changes to occur, both physically through the implementation of certain practices, and in peoples' minds and hearts. There is no doubt that in three years' time PMR initiated considerable changes in sustainable natural resource management practices and associated perceptions of farmers in the Ccarhuayo district. These changes lasted at least 1.5 years after project closure, were replicated at other locations and formed the basis for new farming systems. In the worldwide search for practical and effective approaches to tackle the problem of land degradation and poverty in rural communities, the PMR approach could serve as a very interesting example.

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