

MANAGEMENT OF DRAUGHT ANIMALS: PARTICIPATORY RESEARCH IN BOLIVIA

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Introduction

The concept of PROMETA (*Proyecto de Mejoramiento de Tracción Animal*) has its roots in a preliminary project which investigated the problems associated with working animals that smallholder hillside farmers had in the inter-Andean valleys of Bolivia. Rather than suppose, from the outside, what the problems may be, a detailed study was conducted in close collaboration with the farm families.

In the initial stages of the preliminary project, Participatory Rural Appraisals (PRAs) were conducted in six communities in three provinces of Cochabamba Department (Dijkman and Sims, 1997; Sims, *et al.*, 1997). The PRAs lasted three weeks in each community and culminated in a workshop, in October 1996, to discuss the results and determine the characteristics of a possible program of participatory research. The workshop included representatives of possible future stakeholders (farmers, researchers, NGOs, development institutions) and its principal output was the formulation of a Participatory Research Project - PROMETA.

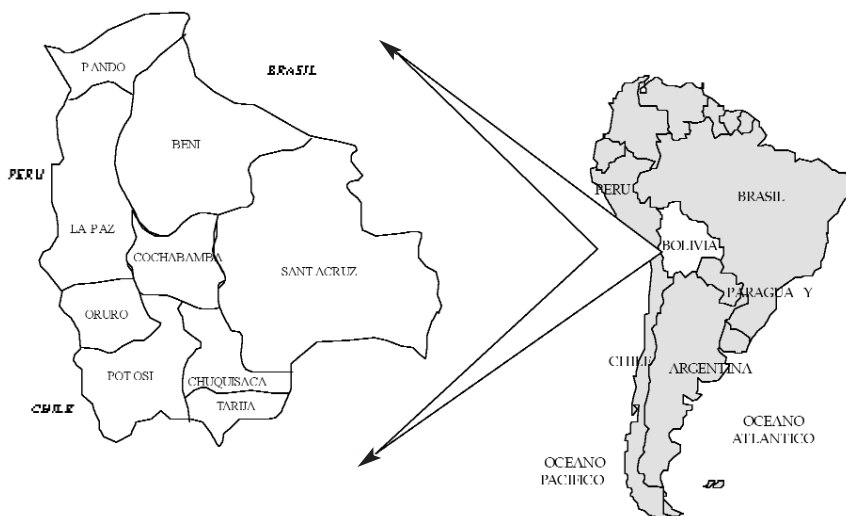
The methodology of the Project and the initial advances have been written elsewhere (Sims *et al.*, 1998). The aim now is to describe the results of the first research projects and to indicate the modifications that were made to our original plan of work.

* speaker

Location

The Project is based in the Center of Research, Training and Extension in Agricultural Mechanization (CIFEMA) of the San Simón University in Cochabamba. The work is carried out in six communities within the Department of Cochabamba (Figure 1) with the physical and climatic characteristics described in Table 1.

Figure 1: Location of the Department of Cochabamba, Bolivia



Capinota

The communities of Capinota Province are characterized by silty alluvial soils in the valleys of the Arque River. Potato is the most important crop along with vegetables (carrots, garlic and onions). As the region has irrigation, two or sometimes three crops are possible annually. The size of family properties ranges between 0.2 and 7 ha, and some families manage flocks of goats and sheep in the neighbouring hills. The most common form of farm power is oxen (*la yunta*), although single horses and donkeys are used for light draught tasks (such as ridging vegetables) and tractors for initial soil cultivation.

Table 1: Characteristics of the six communities collaborating with PROMETA.

Department of Cochabamba

			Rainfall		Temperature	
Communities	Province	Altitude masl	Annual mm	Months	Annual mean °C	Risk of frost
Sarcobamba and Sarco Kucho	Capinota	2400	530	Nov - Mar	15	May - Jul
Piusilla and San Isidro	Ayopaya	3400 - 3800	650	Nov - Mar	15	May - Aug
Kolque K'oya and Boquerón K'asa	Tiraque	3580	530	Dec - Mar	11	May - Sept

Ayopaya

These communities are located in broken terrain over a range of altitudes. Potato is the most important crop and is always sown first in the rotation. Potato is followed by maize, oats and broad bean, according to the altitude and availability of irrigation. There is always a prolonged fallow period (up to eight years) after the crop rotation. Each family has 0.3 to 3 ha and, in addition, have access to communal areas of high *puna* for pasture and cultivation. Almost all families have their own *yunta* (oxen) for power and will also have donkeys and horses, principally for transport.

Tiraque

The communities of Tiraque are also on broken, hilly terrain, but not to the extent of Ayopaya. Here the rotation also starts with potato, followed by small cereals (oats or barley) and legumes (tarwi, *Lupinus mutabilis*, or broad bean). The areas with irrigation can produce two crops per year and each family has between 0.1 and 5 ha. Almost all families have donkeys and yuntas and about 10% also have horses for transport.

Participatory Research

On initiating the research program, the concerns and priorities of the farmers that had been identified in the 1996 workshop were taken into account. As PROMETA forms part of the UMSS, a series of thesis themes was formulated in the first period of consultative participation (Sims and Bentley, 1998). Nevertheless we saw that this methodology, whilst being ideal for thesis oriented research, was not so good at addressing fully the problems of the farmers and involving them in the research process (Bentley, 1998). The experimental designs, whilst taking place on-farm in full consultation with the farm families, were more allied to the norms of formal research. The work model that we have now adopted involves having the presence of field technicians in the communities for a complete week. The two technicians take and demonstrate the technologies being developed in PROMETA as a result of consultation with farmers. The presence of the technicians in the

communities for relatively long and pre-programmed periods facilitates the exchange of information, the refinement of practices and assures that the participation is **collaborative**. It would have been desirable to have included a Quechua speaking woman in the team, nevertheless we are putting emphasis on including the views of women in the evaluations of the technologies, and on incorporating their ideas in future themes for research.

Results

The research in progress covers three broad areas of work relating to working animals:

- Animal health;
- Equipment and harnesses;
- Animal nutrition.

In the following sections we describe the principal achievements to date.

Animal health

As a result of the workshop where a lack of veterinary services for the communities was identified, a study was commissioned on the need and priorities of animal health (de Roover, 1997). During this study it was identified that, thanks to the initiatives of the NGOs, ASAR and CIPCA, the situation on the supply of veterinary services had already been considerably improved in some communities since the workshop. This had been achieved through programs of training para-veterinaries. Nevertheless, the achievements of the NGO initiatives do not cover the whole of Cochabamba Department. Consequently PROMETA financed the training of veterinary technicians (through a CIPCA program) in the Project's communities that to date had not had access to these services. A further recommendation of the study was the need to improve and increase the equipment and medicines for the para-veterinaries already providing a service, through the establishment of veterinary pharmacies.

In 1998, in collaboration with the *Carrera Veterinaria* of UMSS, PROMETA initiated two degree theses focusing attention on parasites (both internal and external). The infestation by different classes of parasites is the most prevalent problem of working animals, affecting their health, nutrition and performance. One research theme is the identification and determination of the parasitic load on working animals (bovines and equines) in the different seasons of the year. Further work will compare the efficacy and profitability of a range of commercial parasite control products. The second research theme will study the importance of different intermediaries in the transmission of parasites to working animals and will compare the efficacy of traditional natural medicines with commercial products. These studies are yet to be approved and at the moment there is no further information.

Equipment and harnesses

A priority identified by farmers is the diversification of the use of their working animals. Many farmers have equines (donkeys and horses) that are principally used for transport. In collaboration with Frank Inns, PROMETA has developed and evaluated a line of light-

weight equipment for single equines together with high-lift harnesses all locally manufactured (Inns, 1998).

It is important to remember that the combination of light equipment and high-lift harnesses is advisable in order to take advantage of the reduction in draught force produced by the high pull angle. In a thesis study, Julio César Antezana has tested the work produced by horses and donkeys with different harnessing arrangements on a circular test track. The track comprises a central pivot with an arm attached to a sledge which can be loaded with weights and so vary the draught force required by the animal (Figure 2).

Three types of harness were compared:

- A collar harness consisting of a leather covered metal or wooden collar connected to the traces and swingle tree;
- A traditional harness comprising a breast band connected to wooden traces with wooden separators;
- A high-lift harness.

Figure 2: The test track for single equines pulling a variable load with different harnessing arrangements



A full day was worked with each type of harness (6 hr for the horse and 4 hr for the donkey) under a regime of 30 minutes of work followed by 10 minutes of rest. The load was increased each day until the animal started to display symptoms of fatigue. Figure 3 shows that the high lift harness not only demanded less draught force for a determined load on the sledge, but also allowed the animal to work for a greater number of days without becoming over-tired. Similar results were obtained with both horses and donkeys.

The most important evaluations are those carried out by the farmers themselves, and this is being done in Capinota and Ayopaya. The harnessing arrangements described were used together with the new light-weight implements. The trials (which followed procedures

described by Smith *et al.*, 1994) showed that the high-lift harness and new implements were superior. The success of this development process has been demonstrated by the demand generated. In less than a year the equipment and harnesses have been developed and a batch of 20 ploughs and ridgers for equines has been produced and the first sales to farmers have been achieved (Figure 4).

Figure 3: Maximum forces sustainable by a horse throughout the working day

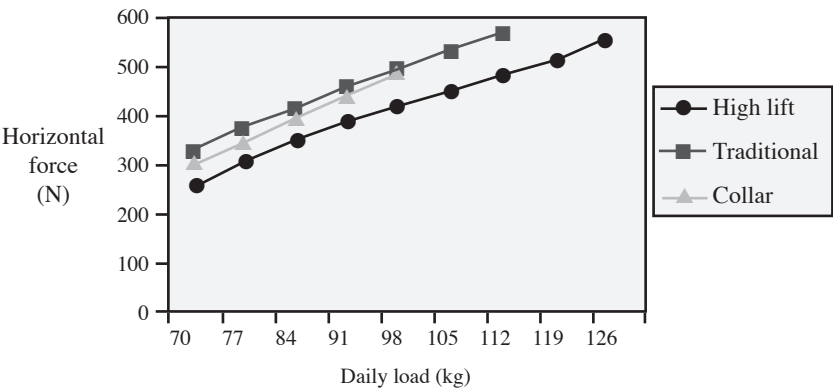


Figure 4: A moldboard plough in the process of participatory evaluation in Capinota

The success of initial research and the incorporation of farmers' ideas in the design has resulted in the manufacture of a batch of 20 units of ploughs and ridgers for donkeys and horses.



New cultivation equipment for equines

Work on new lines of light-weight equipment for equines has been initiated. Because of the interest shown by farmers to maximize the use of rainfall, we are studying the effect of chisel ploughs (*coutriers*) on the infiltration of the first rains in compacted and crusted soils. Designs with small lateral wings have a much greater soil bursting effect and the subsequent capacity to absorb run-off water.

Soil and water conservation on hillsides can be done by means of contour planted live barriers as our sister Hillsides Project is doing in Bolivia. The establishment of live barriers promotes the formation of terraces on hillsides and work on the developing terraces is facilitated by the use of reversible ploughs. Continuing the theme of diversification of equine use, we are working on prototype designs of reversible ploughs for single horses.

Carts for yuntas and equines

Patricia Torrejón's thesis has resulted in the technical and economic evaluation of a cart for a yunta of oxen. In collaboration with a rural development project, FAO Fertisuelos, we have built four cart units for on-farm evaluation. The cart is based on the fundamental design used by the Mennonite farmers of Santa Cruz Department, with its hitching system modified to accommodate the *yunta* with a rigid draw pole and a braking system actuated both from the front and the side of the cart. In the participatory evaluations, the cart was outstanding in comparison with the human and equine transport alternatives. However the cost of the cart must be reduced to come within reach of the target clientele of farm families (\$US400 is much too high).

At the moment we have started work on the design and manufacture of two cart designs for equines. They are characterized by being lightweight, easy to manufacture and incorporate design features which have proved popular with farmers in other countries.

Participatory evaluation of tillage systems for potato

Thesis student Juan Carlos Céspedes is comparing hillside tillage systems with the aim of protecting the fragile soils being farmed under these conditions. Technical, economic and participatory evaluations have compared the traditional ard plough with a reversible plough, a chisel plough and the *arado combinado* manufactured by CIFEMA. The chisel plough showed good potential for single animals as it required less draught force than the other options. However, further tests are needed to determine the impact on subsequent yields in different crops. In the participatory evaluations, the reversible plough was always the favoured option.

Animal nutrition

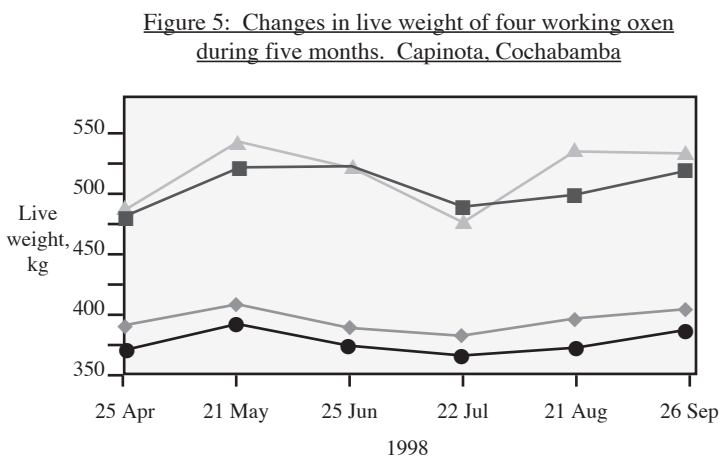
The third element in the research portfolio is the nutrition of working animals. Three thesis investigations are looking at aspects of nutrition, one on actual practices and the other two on possible improvements.

Feeding systems

Victor Copa is making a diagnostic study of feeding systems of work animals in Capinota and Tiraque. The aim is to identify the periods of deficient feeding with respect to work load, and propose strategies for improved feeding in the critical periods of the year. The aims are being achieved through monitoring:

- Existing feeding systems for each climatic season;
- The energy requirement of the farm work;
- The nutritive requirements of work animals;
- Quality and quantity of the feed offered and the difference between seasonal supply and demand.

As an illustration of the type of data being collected, Figure 5 shows the changes in live weight of working oxen in Capinota.



Improved pastures

Melby Rodríguez has studied the effect of improved pastures on the availability of forage for animals in Ayopaya and Tiraque. Working animal feed is based on maize, oat and barley stover, grazing in communal pastures or fields in fallow and potato foliage, according to the climatic conditions and the crops produced in each zone. Establishing improved pastures in fallow fields could constitute an important source of forage without competing with commercial crops, and possibly with the benefit of better soil fertility for the next crops. Seven species of forage crops were sown⁴ in fields destined for fallow and the following aspects were monitored:

⁴ *Bromus catarticus*; *Lolium perenne*; *Festuca arundinacea*; *Eragrostis curvula*; *Trifolium repens*; *T.pratense*; *Vicia sativa*

- Establishment;
- Growth rates;
- Biomass yield;
- Analysis of nutritional value.

Economic and participatory evaluations were also conducted.

Figure 6 shows the changes in population of the different species during the first six months of life in one of the established pastures. Figure 7 shows the production of dry matter over the same period.

Figure 6: Change in population over time
of seven forage species. Plants m⁻²

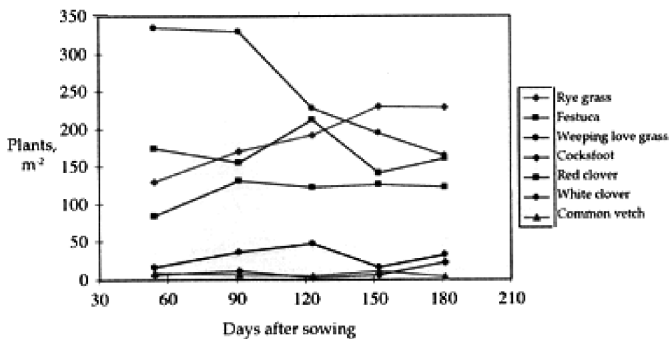
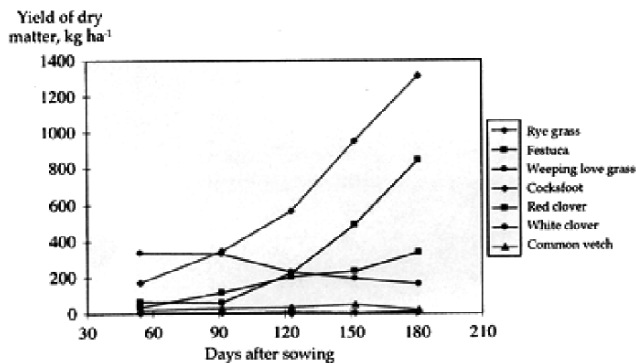


Figure 7: Dry matter production during six months of
growth of seven forage species. kg ha⁻¹



The species which were best adapted to the Piusilla region were *Lolium perenne* (ryegrass) and *Trifolium pratense* (red clover) when there is more or less constant soil moisture. Where there is little soil moisture *Eragrostis curvula* (weeping love grass) showed good growth characteristics. The worst adapted was *Bromus catarticus*, and *Festuca* and *Trifolium*

pratense (white clover) had a very low growth rate and dry matter yield and were at a disadvantage compared with the weeds present. Farm family acceptance of the practice has been extraordinary and there is now a high demand for more seeds to extend the innovation.

Small cereals for forage

Silvio Nina is studying the value as forage of three small cereals as pure stands and associated with common vetch (*Vicia sativa*). The work has been done in Ayopaya and Tiraque with the aim of increasing both the quantity and quality of forage for working animals. The three cereal species were oats (*Avena sativa*), barley (*Hordeum vulgare*) and triticale (*Triticosecale*). The technical evaluations consisted of:

- i) Determination of the dry matter production and the nutritional quality of the cereals as pure stands and in association with the legume;
- ii) establish the effect of N fertilizer on yield and quality of the cereals. As always, economic and participatory evaluations were included. Table 2 summarizes the data on cereal dry matter yields.

Table 2: Means of dry matter yield of three species of cereals in pure stand and associated with vetch. Level of fertilizer 16-4-00

	Dry matter yield t ha ⁻¹		
Cereal	Pure stand	Associated crop	Common vetch
Barley	3.3 c	2.5 c	0.03 b
Triticale	5.3 b	4.1 b	0.08 a
Oats	7.2 a	5.8 a	0.08 a

Means within a column followed by different letters are significantly different (p = 0.05) Duncan's Multiple Range Test

Main findings are:

- Oats is the cereal which produces most dry matter; it is also preferred both by farmers and their animals;
- Pure stands always produce greater yields of cereal dry matter;
- Barley, because of its early competitiveness, does not allow the vetch to prosper;
- Levels of gross protein (645 kg ha⁻¹) and crude fiber (28%) showed no difference between cereals;
- Common vetch produced more dry matter with triticale and barley. Yields are low due to light competition;
- The legume improves the forage quality through its addition of total protein, but a better effect is achieved (with more dry matter) with pure cereals and N fertilizer;
- It is more profitable to produce better quality forage in pure stands with N fertilizer, than by associated crops.

Future Work

As was discussed in the Participatory Research section, PROMETA intends to concentrate its resources and more **collegial** research where the farmers take more control and make more decisions. We have seen that the scientific rigour needed for degree thesis research does not always combine well with the development of a climate of confidence between farmer and scientist. But, what is certain is that farmers are looking for technical solutions to their problems, and that there will be great demand for practical solutions to these problems.

Without any doubt, the areas of need already identified (health, nutrition, equipment and harnesses) are still the most important and the role of the scientists is still that of identifying technical solutions to problems articulated by the farmers. That is why we are confident that the more continuous presence of PROMETA's technical personnel in the communities should result in an improvement in the relationship between PROMETA and those communities and, as a result, better adoption of the fruits of the Project's research. Amongst the next topics programmed for participatory investigation are:

- Improvement of the line of tillage implements for single animals (chisel plough, cultivator, reversible plough, harnesses and yokes);
- Construction and evaluation of prototype carts for single equines;
- Combination of hillside soil and water practices and forage production;
- Formulation of animal feeding strategies for critical periods of the year;
- Parasite control with alternative and traditional medicines;
- Work animal stabling;
- Forage conservation.

In addition to the research program we are promoting the dissemination of the results of our investigations. We will promote, for example, the manufacture and distribution of those tools and equipment that have merited acceptance by farmers, and the production and diffusion of seed for improved pastures.

A key element in the success of PROMETA will be its integration into the international systems of information dissemination (eg via the Latin American Animal Traction Network - RELATA), and we also want to forge alliances with other projects aiming to improve the welfare of rural communities, as, for example, the Hillside project of UMSS and others both regionally and internationally.

Summary

The PROMETA Project (*Proyecto de Mejoramiento de Tracción Animal*) was initiated in 1997 after a preparatory phase that was finalized with a stakeholders' workshop in 1996 to formulate the research agenda. In the course of its first year the Project has worked with thesis students from the Agronomy Faculty of the San Simón University (UMSS) in Cochabamba in a range of fields: development of equipment and harnesses for working animals (tillage equipment, harnesses and carts), animal nutrition (improved pastures, forage production) and animal health (parasite control). In its second year the Project is reducing the participation of thesis students and is increasing the role of the farm family in

all stages of the participatory research. The research program will pursue the same broad themes, but with more control on the part of the farmers. PROMETA aims to manufacture and disseminate the fruits of its labours, already enjoying a demand, and to increase its integration with other projects with similar aims, both within Bolivia and internationally.

Key words: Work animals, participatory research, equipment, nutrition, health

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