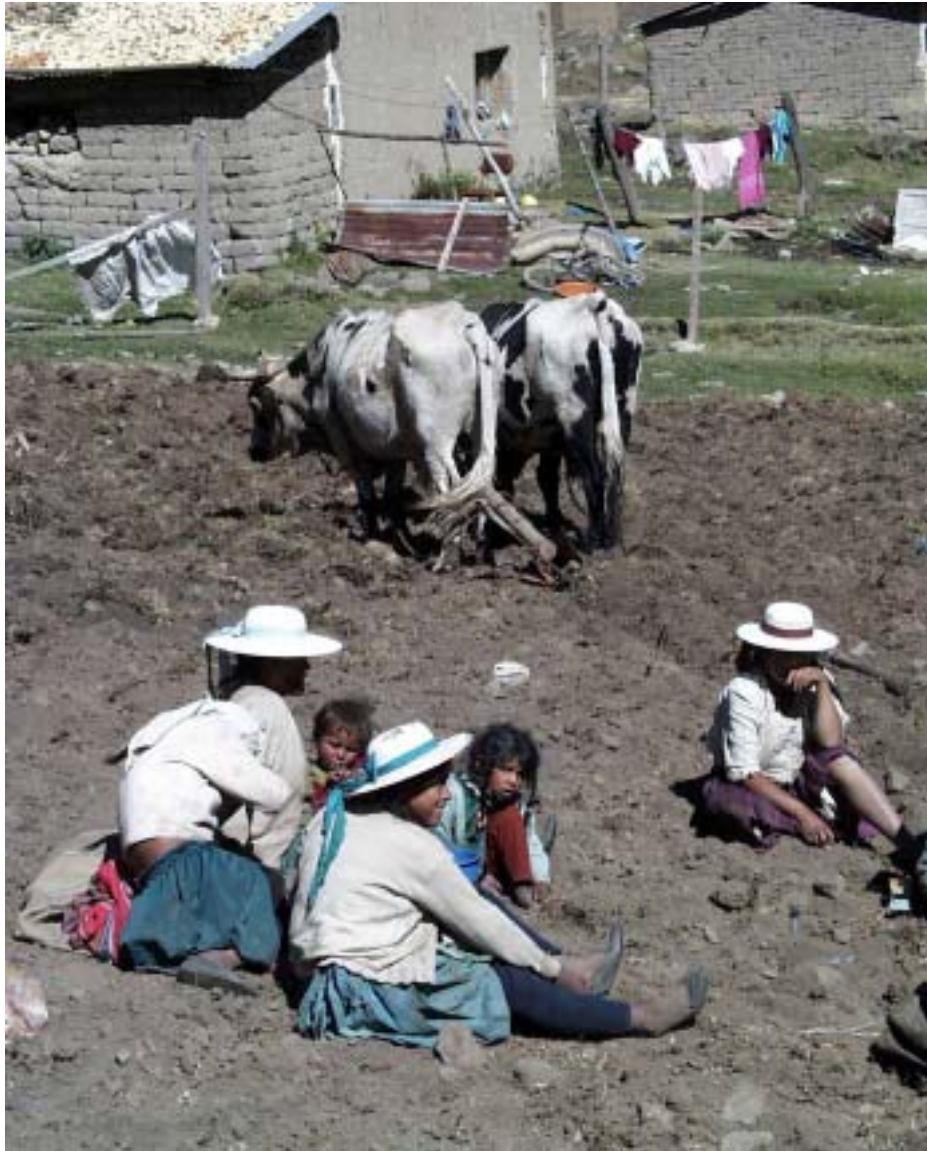


Final Technical Report R6970

Improved management and use of draught animals in the Andean hill farming systems of Bolivia



**International Development Group
Silsoe Research Institute
Wrest Park, Silsoe
Bedford MK45 4HS
England**

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LIVESTOCK PRODUCTION PROGRAMME

**Improved management and use of draught animals in the Andean
hill farming systems of Bolivia**

R 6970 (ZC 0074)

FINAL TECHNICAL REPORT

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Project Leader: Brian G Sims

Project Leader's Institution: Silsoe Research Institute

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ACRONYMS

ASAR	Asociación de Servicios Artesanales y Rurales
ATNESA	Animal Traction Network for Eastern and Southern Africa
AUTAPO	Apoyo a las Universidades de Tarija y Potosí
CCM	Comité Central Menonita
CEDICA	Centro de Educación y Desarrollo del Campesinado
CIAT	Centro Internacional de Agricultura Tropical
CIFEMA	Centro de Investigación, Formación y Extensión en Mecanización Agrícola
CIMMYT	International Maize and Wheat Improvement Center
CIPCA	Centro de Investigación y Promoción del Campesinado
CPP	Crop Protection Programme
DESEC	Centro para el Desarrollo Social y Económico
DFID	Department for International Development
DM	Dry Matter
ETSA	Escuela Técnica Superior
FCAPFyV	Facultad de Ciencias Agrícolas, Pecuarias, Forestales y Veterinarias
ILRI	International Livestock Research Institute
N	Nitrogen
NGO	Non-governmental organisation
NRI	Natural Resources International
NRSP	Natural Resources Systems Programme
PDA	Plan de Desarrollo del Area (World Vision)
PRA	Participatory rural appraisal
PRODEVAT	Proyecto de Desarrollo de los Valles de Arque y Tapacarí
PROINPA	Proyecto de Investigación en Productos Andinos
PROLADE	Proyecto Laderas
PROMETA	Proyecto de Mejoramiento de Tracción Animal
PROMMASEL	Proyecto de Manejo Sostenible de Malezas en Laderas
RELATA	Red Latino Americana de Tracción Animal
RENTA	Red Nacional de Tracción Animal (Bolivia)
UMSS	Universidad Mayor de San Simón
UNIVEP	Unidad Nacional de Vigilancia Epidemiológica y Control de Enfermedades Animales
USAID	US Agency for International Development

EXECUTIVE SUMMARY

A series of participatory rural appraisals carried out in the Cochabamba Department of Bolivia, together with a confirmatory workshop attended by community representatives, intermediate users and scientists, identified draught animal husbandry, implements and soil and water conservation as major limiting factors in the region's farming systems (*DFID project code: R6605, NRI project code: A0511*).

In response to this identified need, this Project carried out research in three provinces of the Cochabamba Department (Ayopaya, Capinota, Tiraque). These were chosen because they represent the broad spectrum of agro-ecological zones, socio-economic circumstances and draught-animal usage within the region. The Project focussed on the participatory selection and evaluation of improved animal husbandry techniques, implements for the more efficient and diversified use of the available work animal resources, and technologies for improved soil and water conservation.

In each of the six collaborating communities the research work was co-ordinated through a group of collaborators, elected by the communities and confirmed by the local grass-root organisations. These groups organised and co-ordinated the involvement of the wider community in the implementation of farmer-participatory trials and the continuous iterative process between the communities and the Project, that formed the participative basis for the development of technologies and strategies. In addition, the Project has also implemented its activities and organised the wider promotion of its outputs through a range of different organisations and institutes.

The Project has developed, evaluated and disseminated recommendations for the cultivation, use and conservation of fodder and for sowing pastures on fallow land. Paravets have been trained in the communities and guidelines for the control of parasites in work animals developed. Various animal health and nutrition courses have been given by the Project both at community and university level. In addition, appropriate tillage and rural transport equipment and harnesses to diversify the use of equines and bovines have been developed, tested, evaluated and disseminated. Many of these tillage and rural transport tools and harnesses are now being manufactured and sold commercially. The only limitation to greater adoption of the developed technologies is the CIFEMA factory's capacity.

Links between R6970, R6621 (NRSP - Soil and water conservation on Bolivian hillsides) and R7579 (CPP – Forage production and erosion control) have led to synergy in the development of vegetative conservation measures, which also serve as work animal forage banks in the dry season. The establishment of vegetative contour barriers has resulted in modifications of animal use and the Project has developed equipment (reversible ploughs, vertical tillage implements) for single animals (equines and bovines) to aid the formation of terraces.

During the Project extension year (2000-2001) the focus has been on initiating the evaluation of the impact of PROMETA's outputs, intensifying efforts for dissemination and scaling-up and producing a new project proposal by means of a stakeholder workshop.

BACKGROUND

Work animals continue to make a significant contribution to the livelihoods of the poor in many rural and urban economies. Current estimates suggest that up to two billion people depend on work animals as the main source of power for farm operations (Sansoucy, 1995). However, environmental changes and rapid increases in population densities, in many smallholder production systems around the globe, have meant increased problems for farmers in planning effective resource management strategies. The need to meet the associated demand for increased productivity from declining land holdings has also led to the need for changes in the traditional management of work animals.

The realisation of the continued importance of work animals and the need to improve the efficiency of the available work animal resources has led to a significant increase in the research carried out (Petheram *et al.*, 1989; Starkey *et al.*, 1991). The majority of this work, however, has been carried out in lowland sub-Saharan Africa and Southeast Asia, and few data are available on the role of draught animals within Latin American hillside farming systems. A number of publications have highlighted the particular importance of draught animals in hillside agriculture systems, as they are often, due to the nature of the terrain, the only means of cultivating the land (other than by hand), and transport (Gatenby *et al.*, 1990; Rist, 1991; Zimmerer, 1993; Pariyar and Singh, 1995; Starkey, 1995). In addition, solutions to farmer-felt constraints developed in lowland agriculture systems are often not appropriate to the specific crops, and the climatic and topographical conditions encountered in hillside systems.

To overcome this lack of information, a preparatory study was carried out in the middle Andean hill farming systems of Bolivia, to describe and analyse the prioritised factors affecting draught animal power use. (*Preparatory study on the availability and use of draught animal power in the middle Andean hill farming systems of Bolivia; DFID project code: R6605, NRI project code: A0511*).

The PRA, organised in collaboration with CIFEMA, the FCAPFyV of the UMSS and a number of NGOs, was conducted in six communities in three provinces of the Cochabamba Department in Bolivia. The three provinces were chosen as they represent the broad spectrum of agro-ecological zones, socio-economic circumstances and draught-animal usage within the region. The PRA used informal interviewing techniques and other PRA methods (transects, historical transects, community mapping, seasonal calendars, mobility maps, resource flow diagrams, preference and problem ranking) to obtain basic village data, historical analysis of the communities, farming and livelihood system analysis and livestock and animal traction sub-system data (Dijkman *et al.*, 1999).

These PRAs, together with a confirmatory workshop attended by community representatives, intermediate users and scientists, clearly indicated the need for research into work animal management, implements for animal traction and soil and water conservation techniques for the hillside environment. The Project proposed to address these specific issues within the previously established collaborative framework of CIFEMA, UMSS, NGOs and the NRSP-funded hillside project (R6621). In addition, the Project had access and added to technologies developed and evaluated in the region through its association with RELATA.

References

- Gatenby, R.M., Thapa, B and Shrestha, N.P. (eds.). 1990. Livestock in the hills of Nepal. Proceedings of the second livestock workshop held at Pakhribas Agricultural Centre, 11-16 March 1990.
- Dijkman, J.T., Sims, B.G. and Zambrana, L. 1999. Availability and use of work animals in the middle Andean hill-farming systems of Bolivia. *Livestock Research for Rural Development*. **11(2)**.
- Pariyar, M.P. and Singh, G. 1995. Farm mechanisation in Nepal. *Agricultural Mechanisation in Asia, Africa and Latin America*, **Vol. 26 No. 2**, 55-61.

- Petheram, R. J, Goe, M. R. and Abiye Astatke. 1989. *Approaches to research on draught animal power in Indonesia, Ethiopia and Australia*. Graduate School of Tropical Veterinary Science, James Cook University, Townsville, Australia.
- Rist, S. 1991. Participation, indigenous knowledge and trees. *Forests, Trees and People Newsletter* **13**, 30-36.
- Sansoucy, R. 1995. Livestock – a driving force for food security and sustainable development. *World Animal Review*, **84/85**: 5-17.
- Starkey, P. H., Sirak Teklu and Goe, M. R. 1991. *Animal Traction*. An annotated bibliographic database. ILCA, Addis Ababa.
- Starkey, P.H. 1995. *Animal traction and sustainable agriculture in the Dominican Republic*. Consultancy report prepared for Winrock International Institute for Agricultural Development. 20p.
- Zimmerer, K. S. 1993. Soil erosion and labour shortages in the Andes with special reference to Bolivia, 1953-91: Implications for 'conservation-with-development'. *World Development*, **21(10)**, 1659-1675.

PROJECT PURPOSE

'In one hillside and one forest-agriculture interface system, energy balance of draught animals in traditional work assessed in relation to species, animal size and physiological status, environmental variability, soil type and structure and machinery options, and appropriate feeding strategies developed and promoted.'

Small size of holding and sloping terrain, as well as finance, rules out the introduction of tractors in the Project area. Animal traction is widely used for land preparation and local agricultural transport. Most other field operations, however, are carried out by hand causing significant drudgery for women and children. Farmers perceive that the main problems associated with the use of work animals include poor animal husbandry techniques and the absence of appropriate implements. Moreover, land degradation is resulting from inappropriate tillage and cultivation techniques on sloping land. Under these constraints, falling agricultural production undermines the livelihoods of the rural poor. This, combined with population growth, is contributing to emigration from the area with consequent problems in other parts of the country, principally in the cities of Cochabamba and Santa Cruz, which have experienced extremely high growth rates over the past two decades.

The Project has addressed these constraints through the implementation of research activities that contribute to the improved efficiency and the diversification of use of the available work animal resources by smallholder hillside farmers in the mid Andean valleys. In addition, the Project has implemented activities to develop improved animal management through research, development and dissemination activities in animal health, fodder production, conservation and utilisation, and housing. Finally, the Project has been developing, evaluating and disseminating new tools and equipment for use by work animals as well as land management strategies to address the wider problems of degradation of natural resources, principally land, soil and water, through unsuitable agricultural practices.

Annex 1 gives the Logical Framework of the Project.

RESEARCH ACTIVITIES

The Project has been involved in a wide range of participatory research activities implemented by the collaborative efforts of farmers, project staff, consultants, local institutes, development organisations, local thesis students and other DFID-funded projects (R6621; R7325; R7376; R7579) active in the Cochabamba Department of Bolivia.

The research has been carried out in three provinces of the Cochabamba Department (Ayopaya, Capinota, Tiraque), chosen because they represent the broad spectrum of agro-ecological zones, socio-economic circumstances and draught-animal usage within the region, and consisted mainly of participatory selection and evaluation of improved animal husbandry techniques, implements for the more efficient and diversified use of the available work animal resources and technologies for improved soil and water conservation.

In each of the 6 collaborating communities the research work has been co-ordinated through a group of collaborators (3-5 farmers), elected by the communities and confirmed by the local grass-root organisations. The members of these groups are not only recognised experts on the research issues selected by the communities, but they are also, generally, known local innovators and researchers. The groups organise and co-ordinate the involvement of the wider community in the implementation of farmer-participatory trials and the continuous iterative process between the communities and the Project, that have formed the participative basis for the development of technologies and strategies.

In addition, the Project has been implementing its activities and organising the wider promotion of the outputs achieved through a range of different organisations and institutes. In each of the provinces, specific collaborators were carefully selected on the basis of an established presence within the area and a proven capacity for the development, and the dissemination and diffusion, of technologies and strategies. A full list of these partnerships and agreements for the different zones in which the Project has been active is provided in the list of Project outputs on page 40.

The research activities that the Project has conducted using the operational framework described above, all went through a first stage of participatory selection exercises, during which the communities chose the technological options or strategies to go forward to the participatory evaluation stage. The component research activities implemented for the different priority issues are briefly outlined below. The experimental details of each of these studies can be found in the accompanying Project publications referenced in the report.

Animal husbandry

Animal health:

During the initial stages of the Project the lack of veterinary services in the collaborating communities emerged as one of the farmer-felt priority problems. To offer a solution to this problem the Project organised a participatory study in the Project areas, to investigate the possibilities to provide these types of services in an effective and sustainable manner (de Roover, 1997).

Internal parasites were identified by the collaborating communities as the main health problem affecting work animals. Although farmers know about the existence of commercial veterinary drugs to combat these types of problems, these products are often not available or too expensive. When farmers do obtain and use these products, their lack of knowledge about their proper use often prevents the treatments from having the desired result. Local knowledge about their use of medicinal plants for the control of internal parasites is eroding rapidly, although these plants could provide an appropriate and affordable alternative. Consequently, a research study was set up to compare the efficacy of the most widely available commercial parasite control products -Ivomec and Microtel- and three ethno-

veterinary products - Suico (*Tagetes minuta*), Paico (*Chenopodium ambrosioides*) and pumpkin seed (*Cucurbita maxima*) - in the reduction of internal parasite infestations in work animals (Leiva and Berzain, 1999; Plata and Leiva, 2000; Leiva, 2001).

Farmers in the Project area consider mineral deficiencies to be a real problem for the development and health of their work oxen. To answer these queries, the Project implemented a research trial in the province of Tiraque to determine the effect of two commonly used mineral supplements, common salt and Fertisal, with and without the use of parasite control, on the health status and live weight gain of work oxen. At the same time, this research trial intended to determine whether farmers' perception about the need for mineral supplementation are justified (Calle-Mamani, 2000).

Fodder production, conservation and utilisation

Fodder shortage, poor quality fodder and unbalanced diets, were identified by farmers as the main factors limiting the more effective and efficient use of work animal resources. Chief among the reasons identified for these problems were a lack of land to cultivate forage, shortage of rain and irrigation and the absence of locally available knowledge and information about appropriate high yielding forage species.

As part of the efforts to investigate possible solutions to these problems, the Project implemented a monitoring study in Capinota and Tiraque of existing feeding systems to identify if and how periods of critical feed shortage during the year affected the ability of work animals to comply with their work load, and to describe the feeding strategies currently in use by farmers. In addition, the study intended to identify the need for, and appropriateness of, supplementation or modified feeding strategies during the critical periods of the year (Romney *et al.*, 1999; Copa-Cortéz and Zambrana, 2000; Copa-Cortéz, 2000; Copa-Cortéz, 2001).

Fodder production in the Project area is based mainly on the cultivation of forage oats and barley. To maintain or improve the production of these forages and to improve their nutritive quality, an appropriate source of nitrogen will have to be provided. Two potential options to achieve this are the association of the cereals with a legume or through the use of a nitrogen (N) fertiliser. To investigate these two options, the Project implemented trials in Ayopaya and Tiraque to study the dry matter production and the nutritional quality of a) pure stands of forage oats, barley and triticale and b) stands of these cereals inter-cropped with common vetch (*Vicia sativa*). In addition, the effect of N-fertilisation on the production and quality of the forages in pure and associated cultivation was also determined. Moreover, as in all the research work carried out by the Project, participatory and economic evaluations were included in the research design (Nina and Velasco, 1999; Nina-Martínez, 1999a; Nina-Martínez, 1999b).

The nutrition of work animals in the region is based on maize stover, forage oats or barley, communal grazing, fallow grazing and a range of seasonally available feed resources such as, for example, potato haulm, depending on the climatic conditions and the crops cultivated in each specific area. One potential niche identified to increase the production of available fodder without affecting the production of cash crops, and with the potentially additional benefit of improving soil fertility for subsequent crops, was sowing pastures on fallow land. To identify a number of grasses and legumes appropriate for this purpose in the inter Andean valleys, seven fodder species (*Bromus catarticus*; *Lolium perenne*; *Festuca arundinacea*; *Eragrostis curvula*; *Trifolium repens*; *T. pratense*; *Vicia sativa*) were planted on fallow land, to monitor their establishment, growth, biomass production, and to analyse their nutritional value (Velasco and Rodríguez, 1999; Rodríguez, 1999a; Rodríguez-Chávez, 1999b).

Farmers also perceived their lack of knowledge about conservation practices and the absence of appropriate and locally evaluated forage conservation strategies as a significant constraint to improving the nutrition of their work animals (Figure 1). They hence requested a research trial to be set up, to compare the losses in nutrients and nutritional quality of forage oats stored using the traditional system of open-air storage in stacks or buns, as compared to the storage of the same material under a tarpaulin or a roof (Plata, 2001c).



Figure 1: Open air storage of crop residues in Ayopaya.

Land-use technologies for feed production (see soil and water conservation)

Animal housing

Farmers consider that the absence of sheds or stables to protect work oxen from the elements, negatively affects the health and performance of these animals. To comply with the repeated requests to investigate this issue, the Project initiated a study to identify current animal housing practices in the area and to investigate the potential benefits that may arise from housing draught animals. In two of the Project's provinces (Ayopaya and Tiraque) the communities have constructed a total of eight stables using a simple and low-cost adobe design. Of the pairs of work oxen participating in the trial, one animal is housed in the stable overnight, whilst the other oxen is tied up outside the homestead as usual. Every 15 days the animals are evaluated for their health status and condition score (Smith *et al.*, 1994)¹, and the opinion of the farmer with respect to the performance of both animals registered. During this bi-weekly evaluation animals are also weighed to observe any changes in live weight during the experimental period. In addition, a monthly comparison of manure quality and quantity obtained under both 'housing' systems is also made, to evaluate another potential benefit arising from housing work animals (Plata, 2001b).

Diversification of animal use

For many years, donkeys, together with horses and llamas, provided the only source of non-human transport in the Andean regions of Bolivia. This was mainly in their capacity as pack animals as, due to the nature of the terrain, carts had rarely been an option. The extensive road building projects and the increase in motorised transport, combined with increasing crop yields and development *per se*, have, however, had a dramatic impact on the reduction of use of equines. Nevertheless, the majority of the rural households still own one or two donkeys. Whilst they can be seen tied-up near the homestead or grazing for the majority of the day, they are still employed for operations such as the transport of firewood, fodder and

¹ Smith, D.W, Sims, B.G. and O'Neill, D.H. 1994. Testing and evaluation of agricultural machinery and equipment. Rome. Food and Agriculture Organization of the United Nations. FAO Agricultural Services Bulletin 110. p 111.

agricultural produce. In addition, and importantly, they also still provide a means of emergency transport when no vehicles are available or when weather conditions have made roads impassable to motorised transport (Dijkman and Sims, 1997).

Apart from the primary cultivation, which is done with oxen, all other field operations in the Project areas are traditionally carried out by hand. There are, however, various possibilities to employ equines in low-draught tasks such as for example inter-row weeding. Unfortunately, appropriate implements for these types of operations were not available. However, with the continued increase in the establishment of small blacksmith workshops in many communities across the region and the collaboration of more traditional farm-machinery manufacturers, another objective of the Project has been, as requested by the collaborating communities, to develop and evaluate appropriate low-cost harnesses and equipment for donkeys and horses that allow the more efficient use of this valuable work animal resource.

In addition, farmers requested that a more diversified use of bovines be investigated, and as a result the Project has also worked on the development of a range of harnesses and tools for work oxen.

The participatory development and evaluation studies carried out under this Project component can be classified as follows:

High lift harness and light implements for equines (Inns, 1998a; Gámez, 1999, 2000; Inns and Sims, 2000)

Mouldboard ploughs for donkeys and horses (Antezana, 1999a; Antezana-Coca, 1999b; Antezana and Zambrana, 1999; Zambrana and Antezana, 1999a, 1999b; PROMETA, s.f.b)

Ridgers for donkeys and horses (Antezana, 1999a; Antezana-Coca, 1999b; Antezana and Zambrana, 1999; Zambrana and Antezana, 1999a, 1999b; Gámez, 1999, 2000; Inns and Sims, 2000; PROMETA, s.f.b)

Inter-row weeders for donkeys and horses (Crespo and Villarroel, 2000; Crespo-Zambrana, 2001, Rodríguez *et al.*, 2001)

Reversible ploughs for donkeys and horses (Quiróz and Plata, 2000; Quiróz, 2000)

Carts for equids (Mendoza *et al.*, 1999; Sánchez-Uzeda, 2000a, 2000b)

Equipment for cattle

Single yokes (Flores, 2000; Flores and Mamani, 2001)

Tined rake and scraper (Flores and Aguilar, 2001)

Reversible plough (PROMETA-CIFEMA, 2000)

Seeders for the 'arado de palo' (Martínez, 2001)

Carts for cattle (PROMETA, s.f.b; Mendoza *et al.*, 1999; Torrejón, 1999a, 1999b)

Soil and water conservation

Soil and water conservation is a priority concern for all farmers in the mid Andean hillside systems. Recent changes in climate, population pressure and land availability have led to an ever increasing pressure to intensify agricultural production and the cultivation of ever more marginal areas. Unfortunately, the traditional farming methods have proved unable to maintain or improve productivity in these situations, and the requests for the Project to assist in the development of tools and cultivation strategies appropriate for these have been many. Consequently, the participatory development and evaluation studies carried out under this Project component, have been the following:

Winged chisel plough (PROINPA, 1999; Villena, 2000) to improve water infiltration in dry areas.

Improved fallow to reduce erosion (Velasco and Rodríguez, 1999; Rodríguez, 1999a; Rodríguez-Chávez, 1999b). This area of investigation, identified as a potential niche to increase the production of available fodder without affecting the production of cash crops and with the potentially additional benefit of improving soil fertility for subsequent crops (as described in the animal husbandry section above), also has a great potential to reduce erosion in fallow land. A participatory evaluation of the improved fallow system for this specific purpose was hence implemented.

Direct seeders (Callisaya-Rojas, 1999; Wall *et al.*, 2001). The benefits of direct seeding on soil and water conservation in hillside systems are well known (Wall *et al.*, 2000)². The Project has been involved in the development of a series of prototype direct seeding implements in collaboration with CIMMYT.

Tied ridger (Flores, 2001) to prevent run-off and stimulate the infiltration of rainwater in furrows.

Live barriers to promote the formation of hillside terraces and hence reduce erosion and to provide a source of fodder during the dry season (Sims *et al.*, 1999; Sims *et al.*, 2000).

Dissemination

Apart from the preparation of a large variety of documents for different end-users, the Project has also been actively pursuing other dissemination avenues through the production or organisation of: a) *Extension bulletins*, b) *Video*, c) *TV and radio*, d) *Regional agricultural fairs*, e) *Extension visits*, f) *Field days*, h) *Regional distributors*, i) *National and International draft animal power seminars and workshops*, j) *National and International Conferences*, k) *Local courses*, l) *International courses*, m) *Inter-institutional collaboration*.

The extension phase of the Project (2000-2001) put emphasis on this goal with the following activities being given priority:

- A preliminary impact study of PROMETA's technologies.
- Visits to Universities, regional NGOs and development projects to raise awareness of PROMETA's accomplishments.
- Draught animal training courses throughout the country.
- Production of training videos on various aspects of successful technologies being promoted.
- Participation in regional agricultural fairs.
- Preparation of manuals, technical reports and farmer bulletins.
- Participation in national and international conferences to enrich PROMETA's experience and networking activities and to promote the Project's outputs.
- A planning stakeholder workshop to examine the need for further R&D, dissemination and scaling up.
- Designing, posting and updating the PROMETA website.

² Wall, P., Campero, M., Calle, C and San Martín, R. 2000. Experiencias con la cobertura con rastrojos y la siembra directa en los valles interandinos de Bolivia. Cochabamba, Bolivia. PROCISUR, PROTRIGO, CIAT, CIMMYT. Curso de Siembra Directa en pequeñas propiedades. 2-4 May. pp 1-7.

OUTPUTS

The Project has achieved and in many cases surpassed all the anticipated outputs:

- i. Recommendations for improved management of working animals (feed resources, nutrition, use, health, housing) developed, validated and disseminated;
- ii. Equipment for working animals in hillside environments developed, validated and disseminated;
- iii. Recommendations for improved management for soil and water conservation developed, validated and disseminated.

The following sections provide a brief overview of some of the main results of the component research activities, details of which can be found in the accompanying Project publications referenced in each section and registered in the complete list of Project outputs provided at the end of this chapter.

Animal health

During the participatory study on the provision of veterinary services it became clear that the situation with respect to the availability of these services had significantly improved since the preparatory phase of the project (1.5 years delay between the PRA and the funding of this follow-up study!). This was mainly the result of the efforts of the NGOs ASAR and CIPCA, which had trained a number of farmers in the area as paravets. Nevertheless, the whole Project area had not been covered by these efforts and the Project therefore, in close collaboration with CIPCA, paid for the training of an additional 4 paravets to enable the provision of veterinary services to the whole project area. The Project has also provided additional recommendations to the NGOs active in the subject matter about the requirements to upgrade the existing veterinary kits issued to paravets and the establishment and strengthening of veterinary pharmacies revolving funds, through a diversification of the stocked drugs (de Roover, 1997).

The results obtained during the study that compared different forms of parasite control, showed that Ivomec had the broadest spectrum, reducing the overall parasite burden by 95%. The efficacy of Microtel came second with a reduction in the total parasite burden of 83%, closely followed by Suico with 82%. Paico and pumpkin seed reduced parasite burden by 80 and 79%, respectively. The treatments were most effective against *Trichostrongylus* spp., *Strongylus* spp., *Nematodirus* spp., *Oesophagostomun* spp., *Moniesia* spp., *Ostertagia* spp. and *Cooperia* spp.

The economic and participatory evaluation of the different treatments indicated that although Ivomec and Microtel are very effective, these treatments are rather expensive and farmers would only use them for high value animals. Although the efficacy of ethno-veterinary products is generally lower than that of the commercially available products, they still reduce parasite burden significantly, and they are cheap and available to all farmers. The fact that these potions are also generally easy to prepare, don't require withdrawal periods, act slowly and have little danger of over dosing, are other big advantages to their use (Leiva and Berzain, 1999; Plata and Leiva, 2000; Leiva, 2001).



Figure 2: Internal parasites were identified by the collaborating communities as the main health problem affecting work animals

The results of the mineral supplementation trial showed no significant health or live-weight differences due to the supplementation of minerals. These trial results and the results obtained for the mineral levels in animal feed, show that farmers' preoccupation with the mineral status of their work animals is probably not warranted. The results did indicate, however, that live-weight gain was significantly higher in animals that had been treated against internal parasites (Calle-Mamani, 2000).

Fodder production, conservation and utilisation

The results of the monitoring study indicated that the basic feeding systems in the Project area are a combination of stall feeding and grazing. During the summer month of November, and during the autumn months of March and April, which are also the periods in which feed scarcity is greatest, the animals are normally left to graze the communal lands as they are not used for work. 'Stall' feeding is used to supplement the diets of the animals when the oxen do not have enough time to graze, and when there are other feed resources available, hence allowing the optimised use of the available fodder. These periods also generally coincide with those periods of the year when the oxen are most called upon to work and when farmers prefer the animals to overnight near the homestead. An example of the results shown in Figure 3, clearly shows the great variety in feed resources used during the year, besides the natural grazing, and the importance of so-called 'weeds' and potato haulm as fodder.

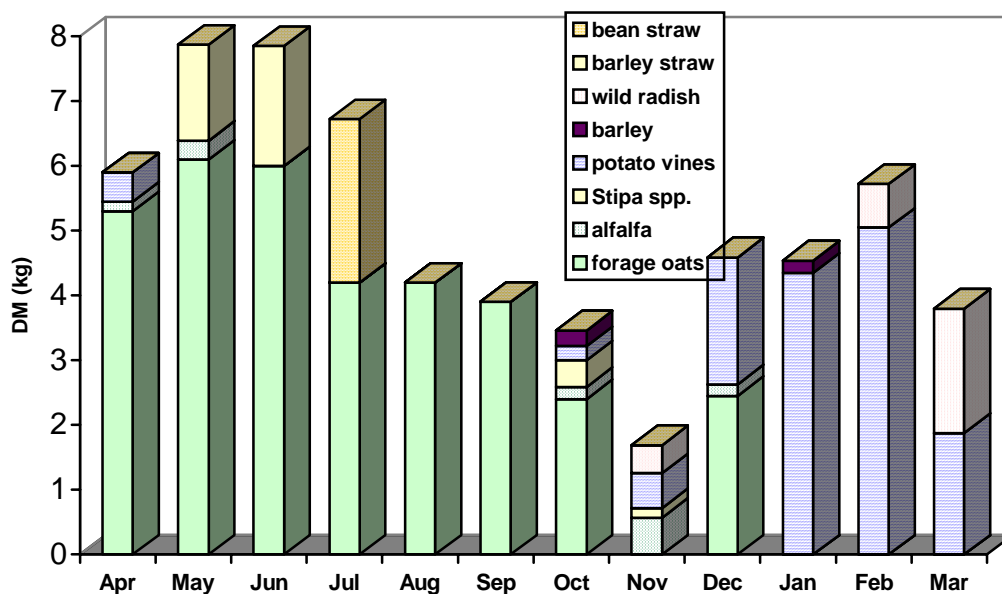


Figure 3: Consumption of stall-fed forage (DM) per ox per day

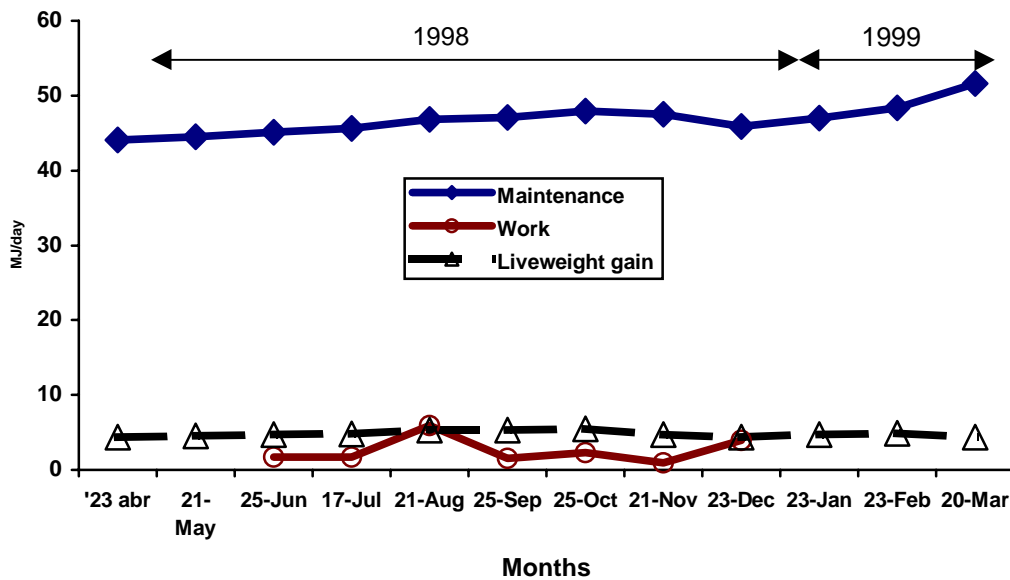


Figure 4: Average metabolic energy requirements (MJ/day) for one ox during the year

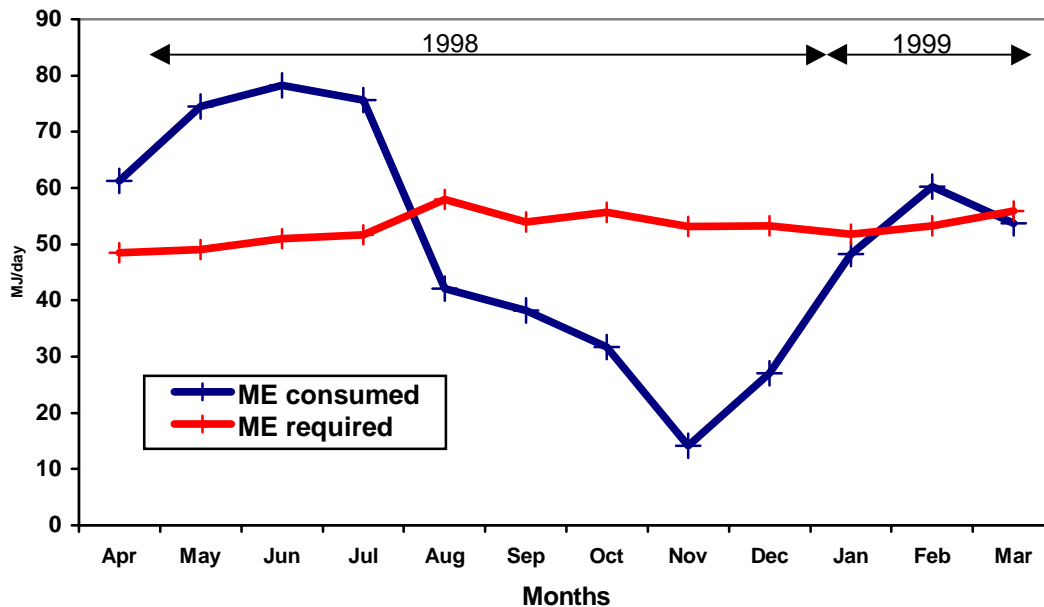


Figure 5: Metabolic energy balance (MJ/day) for oxen during the year

Further results shown in Figures 4 and 5, clearly indicate that work oxen are in energy deficit for a substantial part of the year. Nevertheless, the animals perform the required work without problems and recuperate the lost live-weight without any difficulties during those periods of the year when fodder is plentiful.

Some of the other interesting observations obtained during this study were related to farmers' strategies to optimise the income from the agricultural land they have at their disposal. Generally, farmers prefer to plant potatoes on the majority of the available land as this strategy, during years of abundant rainfall, will provide the highest gross margins per hectare. Part of the income obtained from the potato harvest, is used thereafter to buy forage to feed the work oxen for the remainder of the year. If the potato harvest is bad, however, and there

are no other sources of fodder available, farmers will sell their oxen for slaughter and buy a new pair of work animals at the start of the cultivation season (Romney *et al.*, 1999; Copa-Cortéz and Zambrana, 2000; Copa-Cortéz, 2000; Copa-Cortéz, 2001).

The main results of the investigation into the cultivation of planted forages were as follows:

- Forage oats produced most DM, and was preferred by both the farmers and the animals;
- Although pure stands of cereals, receiving N fertilisation, produced more DM, inter-cropping with vetch allows the vetch re-growth to be used during the periods of fodder shortage;
- There was no significant difference between forages in the production of crude protein (645 kg ha^{-1}) and crude fibre (28%);
- The DM production of vetch is significantly higher in association with triticale and barley;
- Although inter-cropping with vetch improves the quality of the biomass produced due to its high protein content, the DM production of forages in pure stands, receiving N fertilisation, were always higher as compared to inter-cropped stands;
- It is more economically sound to produce forages in pure stands with N fertilisation than in association with vetch. (Nina and Velasco, 1999; Nina-Martínez, 1999a; Nina-Martínez, 1999b).

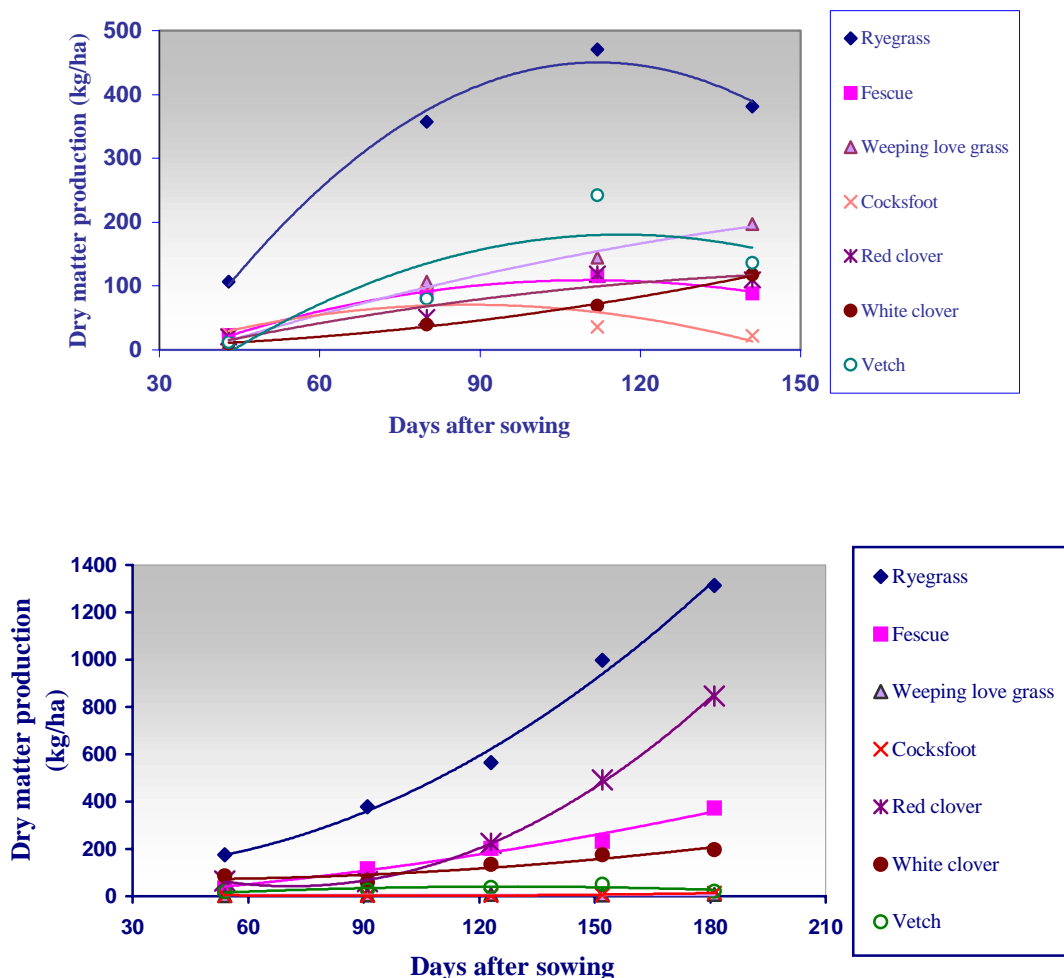


Figure 6: Dry matter yield of two sown pastures

Some of the results of the sown pasture / improved fallow trials are shown in Figure 6. The species that performed best were ryegrass (*Lolium perenne*), fescue (*Festuca arundinacea*) and red clover (*Trifolium pratense*), demonstrating a good adaptation to moderately drained soils and a constant availability of water. On terrain without irrigation, weeping love grass (*Eragrostis curvula*), performed particularly well. The performance of the other forages tested was rather disappointing. The adoption, however, of this system of improved fallow in the collaborating communities has been extraordinary, and the demand for and diffusion of seed of the identified forages following these trials through a number of NGOs has been strong (Velasco and Rodríguez, 1999; Rodríguez, 1999a; Rodríguez-Chávez, 1999b).



Figure 7: One of the established improved fallow areas in Piusilla

Diversification of animal use

High lift harness and light implements for equines

The combination of an increased angle of pull (*c.* 30°) and light implements which require a draught force related to the live weight of the animal, is a new concept in Latin America. This high lift harness significantly reduces the parasitic forces on soil cultivation implements, with little or no influence on the useful work realised. Based on this principle the Project has produced a line of lightweight implements which can all be mounted on the same lightweight metal frame, and which are attached to the harness either through reins or wooden poles (Inns, 1998a; Gámez, 1999, 2000; Inns and Sims, 2000).



Figure 8: The high lift harness used with a light soil cultivation implement

Mouldboard ploughs for donkeys and horses

The designs of these two ploughs are similar, the most important difference being the width of cut, 115 mm and 150 mm for donkey and horse, respectively, and the weight of the implements, 8 and 11.8 kg, respectively (Antezana, 1999a; Antezana-Coca, 1999b; Antezana and Zambrana, 1999; Zambrana and Antezana, 1999a, 1999b; PROMETA, s.f.b).



Figure 9: The donkey and horse mouldboard ploughs developed by the Project

Ridgers for donkeys and horses

The development of these implements has been a great a success, and already they are widely used for inter-row weeding and furrowing/earthing up in crops such as potatoes, maize and broadbeans (Antezana, 1999a; Antezana-Coca, 1999b; Antezana and Zambrana, 1999; Zambrana and Antezana, 1999a, 1999b; Gámez, 1999, 2000; Inns and Sims, 2000; PROMETA, s.f.b).



Figure 10: The ridger for donkeys and horses

Harrow for equines

A light-weight version of the harrow manufactured by CIFEMA for oxen has been designed, evaluated and commercialized by PROMETA, following strong demand from farming communities.



Figure 11. Light-weight harrow for equines

Inter-row weeders for donkeys and horses

The latest implement developed by the Project for the lightweight metal frame used for the mouldboard plough and ridger, were a number of inter-row weeders. The final version of this implement, following the participatory development and evaluation is the one shown in Figure 12, and has proved to be effective and efficient in reducing weed infestation in a wide range of crops on a number of different soil types (Crespo and Villarroel, 2000; Crespo, 2001).



Figure 12: Inter-row weeder for donkeys and horses

Reversible ploughs for donkeys and horses

Two designs of reversible plough have been developed for use with equines. Although they have not reached commercial production for this power source, a larger version has become a successful commercial product for use with oxen (Quiroz and Plata, 2000; Quiroz, 2000).



(a)



(b)

Figure 13: Two designs of reversible plough for equines

Carts for equids

The Project has developed a range of carts for donkeys and horses, one of which is shown in Figure 14. This newly introduced form of animal-powered transport has proved to be both appropriate and affordable for use in rural transport (Mendoza *et al.*, 1999; Sánchez-Uzeda, 2000a, 2000b).



Figure 14: Cart for equines

Equipment for cattle

Single yokes

The lack of fodder during certain periods of the year, as mentioned before, occasionally forces farmers to sell their oxen. The development of single ox systems for use in both primary and secondary cultivation tasks could provide a potential solution for some farmers. Trials on the use of single oxen for weeding, harrowing and transport are still ongoing (Flores, 2000; Flores and Mamani, 2001).



Figure 15: Single ox yokes

Tined rake and scraper

The tined rake and scraper shown in Figure 16, have proved to be particularly useful for farmers who have serious problems with kikuyu grass (*Pennisetum clandestinum*) infestations on their agricultural land, as it allows the grass to be pulled out at the roots. The frame used to mount the tined rake on can also be used to mount a scraper, which has proved extremely useful for the levelling of irrigated fields (Flores and Aguilar, 2001).



Figure 16: The tined rake and scraper

Reversible ploughs

The Project has developed two types of reversible ploughs to facilitate soil cultivation on hillsides between live barriers and to promote the formation of terraces. The two models have a mouldboard that turns 180° on a horizontal axes. The design that has been adopted for initial commercial production, shown in Figure 17, has an integrated ploughshare on each side of the mouldboard, while the other design has a single fixed ploughshare (PROMETA-CIFEMA, 2000).



Figure 17: Reversible plough for oxen

Seeder for the 'arado de palo'

This seeder developed in collaboration with the CCM (Figure 18), has been evaluated very positively by the collaborating farmers and has replaced the seeder that was previously on sale by CIFEMA in the commercial production line (Martínez, 2000).

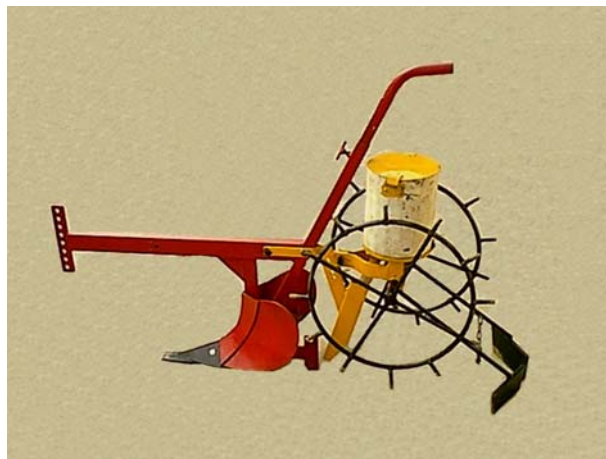


Figure 18: Seeder attachment for the arado de palo

Carts for cattle

Akin to the design developed for donkeys and horses, the Project has also produced a cart for use with oxen, shown in Figure 19. As in the case of the equid cart, this newly introduced form of animal-powered transport has proved to be both appropriate and affordable for use in rural transport (PROMETA, s.f.b; Mendoza *et al.*, 1999; Torrejón, 1999a, 1999b).



Figure 19: Ox cart

Soil and water conservation

Winged chisel plough

The prototype of this plough, shown in Figure 20, has been successfully tested, modified and evaluated on different soil types and is currently entering commercial production in the CIFEMA factory (PROINPA, 1999; Villena, 2000).



Figure 20: The winged chisel plough to improve the infiltration of rainwater

Direct seeders

Although the prototype shown in Figure 21, has been fully tested and evaluated, prior to commercial production, it will be further tested in India and Mexico in collaboration with CIMMYT (Callisaya-Rojas, 2000; Wall *et al.*, 2001).



Figure 21: Prototype of the direct seeder developed by CIMMYT and the Project

Tied ridger

This implement has gone through the normal sequence of field evaluation and has proved very successful in the prevention of run-off and the increased infiltration of rainwater in furrows. The final prototype shown in Figure 22, has recently entered commercial production (Flores, 2001).



Figure 22: The tied ridger developed by the Project

Live barriers

The collaboration on this particular technology, initially with the Laderas research project and then with the British Embassy-funded Laderas dissemination project and ultimately with the CPP-PROFOCE project, has clearly shown the beneficial effect this technology has on the reduction of erosion in hillside cultivation. The technology has also proved popular with farmers as the phalaris grass (*Phalaris tuberoarundinacea*) barriers provide a source of green fodder for the animals during the long dry season. As a result, these live barriers have become a common feature in the Cochabamba landscape (Figure 23) (Sims *et al.*, 1999; Sims *et al.*, 2000). More recent developments (Rodríguez and Sims, 2001)³ have led to the development of associated live-barriers which include legumes with the grass. Of particular interest to farmers is the mixture of phalaris grass and woolly-pod vetch (*Vicia villosa* ssp *dasycarpa*).

³ Rodríguez, F. and Sims, B.G. 2001. Evaluación técnica de barreras vivas asociadas en los valles interandinos de Cochabamba. Paper presented to the II Congreso de Ciencias de Suelo, Cochabamba, Bolivia 19-21 September 2001. 17 pp.



Figure 23: Phalaris grass and woolly-pod vetch used as associated live-barriers on the inter Andean valley hillsides

Dissemination

The extension year was primarily devoted to consolidation, programming, dissemination and scaling up of the Project outputs. The Logframe for the extension year is give in Annex 2.

Extension bulletins

These are predominantly directed towards farming community leaders, researchers and decision-makers in development institutions. As a strategy, the Project produces a published bulletin when a technology has been accepted by farming communities and manufacture or dissemination is actively under way.

Videos

The Project has produced a video in association with CIFEMA. This documentary describes the outputs of the R&D program and is made available to TV channels both locally and nationally. Further videos are being produced on specific technical aspects of the Project's outputs (PROMETA 2001a, b. c. d. e, f).

TV and radio

The Project's public events are usually covered by local radio and TV stations in Cochabamba. Examples are the visits of the British Ambassador, the Project's two national workshops and the III meeting of the Latin American RELATA animal traction network. The Project is also invited to explain its work on specific programmes (Sims, 2001; Flores *et al.*, 2001).

Regional agricultural fairs

Regional fairs (for example the Colomi fair in June 2000) are an excellent route for demonstrating the Project's products. With explanatory panels, well-informed attendants and examples of our products, we can reach a wide and interested audience. The equipment that is shown is generally for sale and requests for community demonstrations are often received.

Extension visits

The Project's close association with CIFEMA means that it has benefited from the latter's extension activities. CIFEMA has two full-time extension agents, equipped with pick-ups, who give practical demonstrations of both the Project's and CIFEMA's equipment in farming communities. These are generally held in association with regional equipment distributors, who benefit from the subsequent flush in sales figures.

Field days

The Project-CIFEMA field days are frequent and popular events in rural communities. Whilst hitherto they have been arranged and financed by the CIFEMA dissemination budget, ultimately they have been requested by other organisations such as NGOs (e.g. PROSANA, CIPCA) and development agencies (e.g. USAID, PRODEVAT).

Commercial production of tools and implements and Regional distributors

The Projects' tools and implements can immediately enter commercial production in the CIFEMA factory in Cochabamba, following their successful participatory development and evaluation. In addition, CIFEMA has a network of rural workshops, a result of its previous rural artisan training scheme. These people typically offer a service of farm machinery repair, but also as sales points for the Project and CIFEMA equipment. There are approximately 90 artisans active in this role. In addition there are retail outlets in the towns of Sucre, Tarija and Potosí, which are more important regionally for larger volume sales. Retail outlets in these three towns have been duplicated in the final year of the Project to provide more volume and greater coverage.

National and International draught animal power seminars and workshops

The Project has organised three national seminars on draught animal power, and has published the contributions as conference proceedings. In addition the Project was asked to host the III Latin American meeting of the RELATA Animal Traction Network.

National and International Conferences

The Project has quickly achieved international recognition as a centre of excellence in its field. We have been asked to contribute to conferences in Argentina, Chile, Cuba, Ethiopia, Honduras, Mexico, South Africa, Syria, Uganda and USA. In addition we have presented aspects of our work to ATNESA, CIMMYT, CIAT, ILRI, and to various universities and institutions in Bolivia (Sucre, Tarija, UNIVEP, PROMMASEL and PROLADE).

Courses

As the Project became confident in the quality of its outputs, and in the demand for them, it has initiated a programme of regional courses. To date these have concentrated on three aspects, training equines for draught work; work animal health and pasture improvement. The manuals on these themes are listed in the publications (Plata 2001a and 2001b). It is envisaged that, as more technologies come on stream, so the demand for farmer-oriented courses on diverse themes will be manifested. In fact, during the final year demand threatened the capacity of PROMETA to supply the courses. Since November 2000 6 courses have been given in Sucre, Potosí and Tarija. More are planned as the Project increases its outreach capacity.

The results of the research and internal seminars have been passed on to a wide student audience through regular farm machinery classes at UMSS and ETSA, a course invited by the Cochabamba Students' Union, as well as invited courses in other Bolivian Universities.

International courses

The Project staff have participated in training course/exchange visits with draught animal power professionals in Honduras, Chile and Cuba.

Inter-institutional collaboration

The Project actively seeks collaboration, generally by means of formal written agreements, with other development organisations. These frequently take the form of joint R&D activities and result in the publishing of student theses. Agreements have been signed with a large number of organisations including CIPCA, PROINPA, ASAR, CCM, etc (See list of project outputs below).

Production of tools and equipment by the CIFEMA factory

	Production Year				TOTAL
	1998	1999	2000	2001 Agosto	
Arado montaña	415	400	100	-	915
Arado combinado	1173	1000	1000	77	3250
Rastra de aletas	163	200	100	21	484
Arado reversible	1304	1200	500	338	3342
Arado Coutier	7	500	100	-	607
Sembradora PROMECA	58	50	-	-	108
Peladora de maní	6	-	-	-	6
Enfardadora de heno	11	100	100	30	241
Desgranadora de maíz	50	50	-	-	100
Trilladora de granos	31	50	50	-	131
Aporcadora de caballo	50	50	200	13	313
Carreta	20	-	10	-	30
Arado reversible "PROMETA"	-	-	30	29	59
Rastrillo	-	-	30	-	30
Niveladora	-	-	30	16	46
Sembradora Promena	-	-	-	50	50
Sembradora siembra directa	-	-	-	15	15
Escardadora	-	-	-	20	20
TOTAL	3295	3600	2250	609	9747

Sale of tools and equipment by CIFEMA

	Price in Bs	Production Year				TOTAL
		1998	1999	2000	2001 (August)	
Arado montaña	300.-	407	300	80	22	787
Arado combinado	300.-	1150	900	750	339	2450
Rastra de aletas	320.-	160	180	95	113	435
Arado reversible	350.-	1278	1000	480	735	2728
Arado Coutier	230.-	7	50	60	10	117
Sembradora PROMECA	412.-	57	50	20	2	127
Peladora de maní	150.-	6	-	10	8	16
Enfardadora de heno	595.-	11	80	95	30	171
Desgranadora de maíz	38.-	49	50	20	4	119
Trilladora de granos	4.08.-	30	50	10	3	90
Aporcadora de caballo	250.-	50	50	100	50	200
Carreta	1.800.-	20	20	8	-	45
Arado-reversible "PROMETA"	300.-	-	-	30	40	30
Rastrillo	300.-	-	-	30	3	30
Niveladora	350.-	-	-	30	20	30
Escardadora	-	-	-	-	13	13
Sembradora Promena	-	-	-	-	10	10
Sembradora siembra directa	-	-	-	-	15	15
TOTAL		3232	2730	1420	1417	7413

PROMETA's Impact

Throughout its four year history the Project has had a series of partial studies on the impact of its efforts and outputs on various stakeholders involved in the development of the small-holder farm sector (Bentley, 1998a and 1998b; Starkey, 1998; Shaw and Sibanda, 2000; Román, 2000, 2000a and 2001; Quinteros-Torrico, 2001; and Plata, 2001).

Institutional Impact

Prior to investigating the impact the Project has had, thus far, on the livelihoods of its client-farmers, it is worthwhile analysing the changes it has caused directly or catalysed within its collaborating organizations and beyond. Such changes can be categorized under three broad headings: awareness, linkages and collaboration, and the mainstreaming of process and methodology.

Awareness

The Project, through its activities, has created broad awareness and recognition of the importance of livestock, in general, and work animals in particular to the livelihoods of poor people and agriculture. It has also clearly shown that the use of work animals is a viable development pathway and that the limited focus of decision-makers on the tractorization of agriculture is inappropriate and unjustified. The Project has also contributed to changes in opinions and habits with respect to the use of different work animals and caused a significant shift in the appreciation of equines, changing their role from beast of burden to a multipurpose power tool for both primary and secondary cultivation tasks. Such changes in attitude and awareness have taken place across the private, public and tertiary sector involved in Bolivian agriculture.

Linkages and collaboration

In the operationalization of its activities, the Project has constructed and established linkages between organizations and institutions, although all are interested in the broad objective of poverty alleviation through agricultural development, they had not previously been linked directly. It has, for example, effectively linked farmers with research organizations and universities, development projects with research projects, the private sector with research and the public sector, GOs with NGOs, and provided training and training materials to a large number of GOs, NGOs, and other educational bodies. Moreover, through its establishment of RENTA it has effectively connected these Bolivian organizations and institutes with similar organizations and processes in Latin America and beyond.

Mainstreaming of process and methodologies

Through its activities, based on the direct and decisive involvement of client-farmers during all stages of the research and decision making process, the Project has contributed significantly to the institutionalization of, and the institutional capacity for participatory research and wider participatory processes. Such developments have been most prominent in the UMSS, the main agricultural university in Bolivia, where prior to the Project theses based on the results of farmer-participatory research were deemed inappropriate, but which have, during the life of the Project, become mainstreamed.

Similar processes can be observed in a number of other public and tertiary sector organizations, where the process of research and development for the identification of viable development and livelihood options is now firmly based on the participation of client communities and end-users.

Livelihood Impact

PROMETA, through its participatory research activities has developed and adapted a wide range of work animal related technologies. Some of these, based on CIFEMA's sales statistics, have already found broad acceptance and adoption within the farming communities. Other technologies have either not yet reached the stage at which they can be commercialised, or have not yet found wide adoption. Nevertheless, the success and adoption of PROMETA's outputs has been remarkable given the short time the Project has been operational and given the limited funds at its disposal. It has empowered farmers and farming communities with a choice of technologies and information that was thus far not available. In doing this the Project has contributed not only to a greater access and control that poor people have over their production assets, but also provided these households with the means to more effectively and sustainably exploit such resources.

The development of the range of equine-drawn implements, for example, for both primary and secondary cultivation tasks, has enabled farmers to improve the efficiency of use of a work animal resource that was previously used solely as a beast of burden. This development has also provided females with the option of using animals for the secondary cultivation tasks, for which they frequently carry the responsibility, potentially contributing significantly to a reduction of drudgery. According to Project data, more than 90% of farming households own one or more equines, and the developed technology thus not only provides the option of using work animals for cultivation purposes to a larger number of people, but it also provides potential access for the poorer segments of the Andean farming societies to such technologies.

The adoption of labour saving technologies, could, of course have significant negative effects on those in society that are dependent for their livelihoods on day labour. However, in the mid-Andean valleys, labour demands are high and supply scarce. The adopted technologies are thus not replacing income generation opportunities for the most vulnerable in society, but rather providing an option to improve the timeliness of operations, to reduce drudgery for family labour, and potentially liberating time that enables the pursuance of livelihood diversification activities.

In its final year the Project has concentrated mainly on the scaling-up and dissemination of its outputs and activities, a task which it has carried out effectively and efficiently. It is proposed however, as it seems increasingly likely that no additional funding will be forthcoming for the proposed future project, that an impact assessment is financed by DFID to clearly quantify and qualify the extensive impact PROMETA has had on both institutional change and the improvement of livelihood options. An appropriate time for this study would be some two years after the end of this Project.

Sustainability of Project impact

Although predictions about the sustained impact of a project's outputs are generally difficult to make, it should be obvious from the above discussion that the groundwork carried out by PROMETA provides a fertile basis for the durable and widespread adoption of the Project's outputs. Such assumptions are based on the adoption that Project outputs have thus far found, following a limited period of commercialisation and relatively restricted dissemination activities. The establishment of effective farmer-research-private sector linkages is another factor that should ensure the widespread dissemination of the technologies. Moreover, the institutionalisation of the Project's methodologies and processes, well beyond its core group of collaborators, through its extensive network activities has already catalysed the use and adoption of the Project's outputs well the farming communities were activities were concentrated.

WEB SITE

PROMETA now has a Web site ([www. prometa-cifema.com](http://www.prometa-cifema.com)). At the moment its contents include the basic technical outputs of the Project, but a steady development programme is under way to improve access to the wealth of information produced by the Project during its four years of work.

FUTURE PROGRAMME

In May 2001 PROMETA hosted its final technical workshop in Cochabamba (Plata and Rojas, 2001). The 36 participants included farmers, researchers, representatives of NGOs , rural development projects and municipal government. In addition to an update of current Project outputs, the group working sessions defined the basis for a new project proposal. The LogFrame for the new project is included as Annex 3. Essentially it comprises three components; participatory technology development; dissemination and scaling-up. This new project is currently being considered by DFID for funding.

LIST OF PROJECT OUTPUTS

Farmer and extensionist bulletins

- ANON. (undated). Bolivia-Reino Unido. Proyectos de investigación participativa en sistemas agrícolas de ladera. UMSS, FCAyP, DFID. 4p.
- FLORES, R. (2001). Arado reversible. Implemento para labor de preparación de suelos. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. 4 pp. Final draft September 2001.
- FLORES, R. (2001). Labores agrícolas con tracción animal. Arado combinado. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. 4 pp. Final draft September 2001.
- PLATA, V. (2000a). Siembra de pastos forrajeros en Morochata. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 28p + Anexos.
- PLATA, V., RODRIGUEZ, F. and SIMS, B.G. (2001). Recomendaciones para un manejo mejorado de suelo y agua en laderas. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. pp 12.. Final draft September 2001.
- PROMETA-CIFEMA. (2000). El arado de vertedera reversible para tracción con bueyes. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. 2p.
- PROMETA, (2000a). Manual de sanidad para animales de trabajo. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 22p.
- PLATA, V. (2000b). Los equinos. Guía de adiestramiento para la labranza de suelos en ladera. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 8p.
- VILLENA, V. (2000). Manejo de animales de trabajo. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 34p.
- PLATA, V. (2000c). Manejo de bueyes y equinos en las zonas interandinas de Bolivia. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 22p.
- PLATA, V. (2000d). Manual para la siembra de pastos mejorados. La alternativa para la alimentación de los animales de trabajo en las alturas. Cochabamba, Bolivia. Universidad Mayor de San Simón. Proyecto Mejoramiento de Tracción Animal. 11p.
- PROMETA, (1998). PROMETA. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón.
- PLATA, V. (2001). Implementos de trabajo, nutrición y sanidad animal desarrollados por Prometa. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. 5 pp.
- PROINPA, (1999). Labranza en suelos secos para la cosecha de aguas: el arado de cincel. Cochabamba, Bolivia. Fundación PROINPA (Promoción e investigación de productos andinos), CIFEMA, PROMETA. Ficha Técnica 1. 4p.

PROMETA (s.f.a) Carreta de bueyes para transporte rural. Cochabamba, Bolivia. Universidad Mayor de San Simón. 8p.

PROMETA (s.f.b) Implemento múltiple para tracción con un solo animal equino. Cochabamba, Bolivia. Universidad Mayor de San Simón. 12p.

RODRIGUEZ, F., ZAMBRANA, L., SIMS, B., WEBB, M., Y VILLARROEL, J. (2001). Control mecanizado de malezas con escardadora de tracción animal. Factsheet. 1000 copies. Spanish. Prometa, Cochabamba, Bolivia. 4 pp.

PROMETA (2001a). Implementos agrícolas para tracción animal. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. 8 pp.

PROMETA (2001b). Uso racional de la tracción animal en sistemas agropecuarios de la región andina. Proyecto mejoramiento tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. (Poster).

Videos

PROMETA (2001a). Logros del Proyecto Mejoramiento Tracción Animal 1997-2001. Script for video to be finalised in October 2001.

PROMETA (2001b). Proyecto Mejoramiento Tracción Animal. Arnés de alto levante. Script for video to be finalised in October 2001.

PROMETA (2001c). Conservación de suelo y agua. Script for video to be finalised in October 2001.

PROMETA (2001d). Sembradora de granos. Script for video to be finalised in October 2001.

PROMETA (2001e). Implemento múltiple de tracción animal. Script for video to be finalised in October 2001.

PROMETA (2001f). Carretas para equinos y bovinos. Script for video to be finalised in October 2001.

PROMETA. 1999a. PROMETA-CIFEMA: Tracción animal. Spanish. 18.5 minutes. Prometa, Cochabamba, Bolivia.

Courses

PLATA, V. (2001a). Curso de capacitación en tracción animal. Proyecto Mejoramiento Tracción Animal PROMETA. Cochabamba, Bolivia. 40 pp

PLATA, V. (2001b). Curso de capacitación en tracción animal. Tomo II. Proyecto Mejoramiento Tracción Animal PROMETA. Cochabamba, Bolivia. 67 pp.

PROMETA (2000). Tracción animal. Facultad de Agronomía de Sucre. November 23-24. Training workshop for researchers, teachers and farmers' organizations 100 participants.

PROMETA (2000). Tracción animal. Facultad de Agronomía de Potosí y AUTAPO. December 13-15. Puna, Potosí. Training workshop for researchers, teachers and farmers' organizations 100 participants.

PROMETA (2001). Tracción animal. Facultad de Agronomía de Potosí y AUTAPO. April 2-4. Training workshop for researchers, teachers and farmers' organizations 50 participants.

PROMETA (2001). Tracción animal. Facultad de Agronomía de La Paz. May 24-26. Choquenaira, Viacha, La Paz. Training workshop for researchers, teachers and farmers' organizations 100 participants.

PROMETA (2001). Tracción animal. PDA and World Vision. Potosí. July 17. Chayantara, Potosí. Training workshop for World Vision and farmers' organizations 50 participants.

PROMETA (2001). Tracción animal. Instituto Superior de Agonomía de la Universidad de Tarija. Yacuiba, Tarija August 9-11. Training workshop for researchers, teachers and farmers' organizations 34 participants (Flores, 2001).

PROMETA (2001). Tracción animal. Mink'a, Potosí. Programmed September 2001.

PROMETA (2001). Tracción animal. CEDICA, Vallegrande, Santa Cruz. Programmed October 2001.

PROMETA (2001). Tracción animal. Facultad de Agronomía Sucre. Programmed October 2001.

PROMETA (2001). Tracción animal. Siglo XX. Facultad de Agronomía de la Universidad Siglo XX, Potosí. Programmed October 2001.

PROMETA (2001). Tracción animal. Facultad de Agronomía de la Universidad de Oruro. Programmed December 2001.

Radio and TV

SIMS, B.G. (2001). DFID's NRM projects in Cochabamba, Bolivia. Visión global – acción local. TV interview. *PORTAL, SITEL*. 4 June (19:30) 30 minutes. Bolivia (national). Spanish.

FLORES, R., PLATA, V. and COPA, V. (2001). Tracción animal. Rendimientos del Proyecto PROMETA. TV interview. Canal 13 de Tarija. 8 August. 30 mins. Spanish

Agricultural and Trade Fairs

2000

Feria exposición agropecuaria, Colomi June 2000

Feria anual agropecuaria, Tiraque, October 2000

Feria Naturex, Cochabamba, August 2000

Feria agroecológica, Comarapa, Santa Cruz, November 2000

2001

Feria universitaria de tecnología e industria, February 2001

Feria agropecuaria Colomi, July 2001

Feria agropecuaria, Sacaba, August 2001

Feria agropecuaria y tecnológica, Capinota, August 2001

Feria Naturex (Agroecológica) Cochabamba, August 2001

Feria agropecuaria, Sipe Sipe, September 2001

Refereed publications

- DIJKMAN, J.T., SIMS, B.G. and ZAMBRANA, L. (1999a). Availability and use of work animals in the middle Andean hill-farming systems of Bolivia. *Livestock Research for Rural Development*. 11(2).
- INNS, F. (1998a). High-lift harness and lightweight plough: An efficient low-draught ploughing system. *Landwards* (UK), Spring 1998. pp 12-16.
- SIMS, B.G. and O'NEILL, D.H., 2001 The role of draft animal power in soil and water conservation. In: García-Torres, L., Benites, J. and Martínez Vilela (eds): Conservation agriculture, a worldwide challenge. I World Congress on Conservation Agriculture, Madrid, October 2001. Volume II: Offered Contributions. pp 121-125. ISBN: 84-932237-2-7.
- WALL,P.C., ZAMBRANA, L., SIMS, B. and CALLISAYA, A., 2001. Development of an animal drawn zero tillage seeder for small grains: In: García-Torres, L., Benites, J. and Martínez-Vilela (eds): Conservation agriculture, a worldwide challenge. I World Congress on Conservation Agriculture, Madrid, October 2001. Volume II: Offered Contributions. pp 631-635. ISBN: 84-932237-2-7.
- ZAMBRANA, L. and ANTEZANA, J.C. (1999a). Uso del caballo como tracción. *Campo y técnica* (UMSS, ETSA, Cochabamba, Bolivia). 2:23-29.
- ZAMBRANA, L, SIMS, B.G. and DIJKMAN, J.T. (1999). El Proyecto PROMETA en Bolivia. *Boletín epidemiológico* (Santa Cruz, Bolivia). 1:26-29.

Popular articles

- ANON. (2000). On-farm assessment of CIFEMA horse carts in Bolivia. International Forum for Rural Transport and Development. 8(1): 4.
- ZAMBRANA, L, SIMS, B.G., DIJKMAN, J.T. and GÁMEZ, P. (1999a). Participatory research for working animal management: the PROMETA project in Bolivia. *Livestock talk* (Livestock Production Programme, Department for International Development, UK). 2:1 and 8.
- ZAMBRANA, L., SIMS, B.G., DIJKMAN, J. and GÁMEZ, P. (1999b). El impacto de la investigación en mejoramiento de animales de trabajo: el proyecto PROMETA en Bolivia. *Draught Animal News* (Edinburgh) (31): 9-12.

Conference papers

- ANTEZANA, J.C. (1999a). Diversificación de animales de trabajo en la agricultura. Desarrollo de arneses y aperos para equinos. *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 41-46.
- ANTEZANA, J.C. y ZAMBRANA, L. (1999). Diversificación de trabajo en la agricultura. Desarrollo de arneses y aperos para equinos. *In: Memorias del III Encuentro Latinoamericano de tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 35-38.
- ARTEAGA P., E. y KESSLER, A. (2000). Experiencias del proyecto JALDA con tracción animal para la conservación de suelos en Chuquisaca. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 128-133.
- BRAUL, A. (2000). La Experiencia del Comité Central Menonita con Tracción Animal en el Departamento de Santa Cruz.. *II Seminario - Taller de PROMETA, UMSS*. pp 126-127.

- CALLISAYA-ROJAS, A. (1999). Desarrollo de un prototipo de sembradora de trigo a tracción animal. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 1-5.
- CÉSPEDES-CAMACHO, J.C. (1999a). Evaluación de cuatro sistemas de labranza con implementos a tracción animal en el cultivo de papa en condiciones de ladera. *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 11-15.
- CÉSPEDES-CAMACHO, J.C. (1999b). Sistemas de labranza con implementos tracción animal en el cultivo de papa en condiciones de ladera. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 59-63.
- CÉSPEDES S., E. (2000). Redes para el desarrollo: Hacia un fortalecimiento y adecuación de la red actual de tracción animal de PROMETA-CIFEMA. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 70 – 76.
- COPA-CORTÉZ, V. (2000). Sistemas de alimentación existente en animales de trabajo mediante formulación en paquete computacional. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 117-125.
- COPA-CORTÉZ, V. y ZAMBRANA, L. (2000). Manejo y valor nutritivo de los forrajes en sistemas de producción de los valles interandinos de Bolivia. Cochabamba, Bolivia. Taller sobre el incremento de productividad en pequeñas propiedades con sistemas mixtos. CIMMYT y ILRI. 7p.
- COSSIO, J y SAN MARTÍN, R. (2000). Experiencias en siembra directa con tracción animal en los valles. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 84-92.
- CRESPO, R. y VILLARROEL, J. (2000). Control de malezas con uso de equipos livianos para tracción animal. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 63-69.
- CRUZ, J. y MENDOZA, J. (1999). Diseño, construcción y evaluación de un implemento múltiple para el cultivo de papa. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 75-78.
- DIJKMAN, J.T. and SIMS, B.G. (1997). From beast of burden to multi-purpose power source: Changes in and challenges for the utilization of equines in Bolivia. *International Workshop on Improving Donkey Utilization and Management*. Debre Zeit, Ethiopia, 5-9 May. 10p.
- DIJKMAN, J.T., SIMS, B.G. and ZAMBRANA, L. (1999b). Mejora de tracción animal: Temas y opciones no tradicionales. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 119-124.
- DIJKMAN, J., SIMS, B.G. y ZAMBRANA, L. (1999c). Uso para propósito múltiple de animales de trabajo en sistemas de pequeños agricultores: desafíos y oportunidades en el próximo milenio. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 65-72.
- DIJKMAN, J., ALEMU GEBREWOLD and PEARSON, R.A. (1999). Multipurpose use of work animals in smallholder farming systems. Invited keynote paper presented to ATNESA workshop, September 1999, South Africa. 13p.

- FLORES, R. (1999). Experiencias de participación de comunidades campesinas, en la investigación e interacción con instituciones de desarrollo agropecuario. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 47-50.
- FLORES E., R. (2000). Labranza complementaria y cultural con el empleo de un solo animal (equino, bovino) Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 178-181.
- FLORES, R. (2001). Difusión de tecnología: implementos de tracción animal. In: Vladimir Plata y Angela Rojas (Eds) *Memorias II Taller Nacional de Planificación de PROMETA*. Cochabamba, Bolivia. PROMETA-CIFEMA-UMSS. pp 65-69.
- GÁMEZ, P. (1999). Generación y desarrollo de prototipos. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 65-70.
- GÁMEZ G., P. (2000). Generación y desarrollo de prototipos. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 160-177.
- INNS, F.M y SIMS, B.G. (2000). Avances recientes en la gama de implementos de tracción animal de PROMETA-CIFEMA. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 1-12.
- LEIVA, V.H. y BERZAIN, C. (1999). Efectos comparativos entre antiparasitarios comerciales y desparasitantes naturales en animales de tracción en la provincia Tiraque y Ayopaya del Departamento de Cochabamba. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 185-187.
- MAMANI, P., CONDORI, B., VALLEJOS, J. y ORTUÑO, N. (2000). Implementos de labranza para el manejo del suelo en zonas alto andinas de Bolivia. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 93-97.
- MARTÍNEZ, R. y ZAMBRANA, L. (2000). Diseño y construcción de una sembradora de granos para tracción animal. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 104-110.
- MARTINEZ, R. (2001). Metodología del II taller de planificación en tracción animal. In: Vladimir Plata y Angela Rojas (Eds) *Memorias II Taller Nacional de Planificación de PROMETA*. Cochabamba, Bolivia. PROMETA-CIFEMA-UMSS. pp 71-88.
- MENDOZA, J. y VELASCO, D. (1999). Experiencias de CIFEMA en producción, promoción y difusión de implementos agrícolas para tracción animal. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 71-78.
- MENDOZA, J., TORREJÓN, P. y SANCHEZ, J. (1999). Transporte rural con energía animal. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 155-158.
- NINA, S. y VELASCO, J. (1999). Rendimiento de tres gramíneas forrajeras, en cultivo puro y asociado con veza común. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 29-32.

- NINA-MARTINEZ, S. (1999a). Fertilización nitrogenada y asociación con veza común en rendimiento de avena, cebada y triticale en Morochata y Tiraque, Bolivia. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 143-145.
- PATERSON, R. (1999a). Pastos en las zonas altas de Cochabamba. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 57-63.
- PATERSON, R.T y PLATA, V. (2000). Pastos y forrajes para animales de trabajo en Cochabamba.. *II Seminario - Taller de PROMETA, UMSS*. pp 39-47.
- PLATA, V. y ZAMBRANA, L. (1999). Identificación y determinación de la carga parasitaria en equinos. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 193-195.
- PLATA R., V. y LEIVA V., V. (2000). Comparación entre fármacos veterinarios y fitofármacos en animales de tracción. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 55-62.
- PLATA, V. (2001). Proceso de generación y desarrollo de tecnologías. *In: Vladimir Plata y Angela Rojas (Eds) Memorias II Taller Nacional de Planificación de PROMETA*. Cochabamba, Bolivia. PROMETA-CIFEMA-UMSS. pp 55-64.
- QUIROZ, O. y PLATA, V. (2000). Diseño, construcción y evaluación de un arado reversible para tracción equina en sistemas agrícolas de ladera. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 48-54.
- RODRÍGUEZ, M. (1999a). Establecimiento de praderas con mezcla de gramíneas y leguminosas en la zona de Morochata, Cochabamba, Bolivia. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 179-183.
- ROMÁN, M.A. (2000). Impacto socioeconómico del proyecto Mejoramiento Tracción Animal en el valle de Cochabamba. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 134-159.
- ROMAN, M. (2001). Impacto socioeconómico del proyecto Mejoramiento Tracción Animal en el valle de Cochabamba. *In: Vladimir Plata y Angela Rojas (Eds) Memorias II Taller Nacional de Planificación de PROMETA*. Cochabamba, Bolivia. PROMETA-CIFEMA-UMSS. pp 31-54.
- ROMNEY, D.L. COPA, V. y DIJKMAN, J.T. (1999). PROMETA: aspectos nutricionales. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 51-56.
- SÁNCHEZ-UZEDA, J.C. (2000a). Diseño, construcción y evaluación de una carreta para tracción equina Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 98-103.
- SIMS, B.G., INNS, F., DIJKMAN, J., ZAMBRANA, L MENDOZA, J. (1997). Animales de trabajo en sistemas agropecuarias de producción: El reto de la investigación. *Segundo Encuentro Latinoamericano de tracción animal*. Tegucigalpa, Honduras. 4-6 noviembre. 9 p.
- SIMS, B.G., INNS, F., DIJKMAN, J., ZAMBRANA, L. (1998). Equines in the farming systems of Bolivian inter-Andean valleys: meeting the challenges. *Proceedings of Third International Colloquium on Working Equines*. Mexico City 5-9 October. pp 55-66.

- SIMS, B.G., ZAMBRANA, L. y DIJKMAN, J.T. (1999). PROMETA: el proyecto de mejoramiento de tracción animal en Bolivia. Logros y perspectivas. *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 1-9.
- SIMS, B.G., DIJKMAN, J., ZAMBRANA, L., VELASCO, J. (1998). Avances en investigación participativa y multidisciplinaria en animales de trabajo en Bolivia. *MECA '98*. Facultad de Ingeniería Mecánica Agrícola, Universidad de Ciego de Avila, Cuba. Junio. 12 p.
- SIMS, B.G. and O'NEILL, D.H. (1998). El programa de Desarrollo Internacional del Instituto de Investigación Agropecuaria (SRI) del Reino Unido. *Congreso Latinoamericano de Ingeniería Rural, CLIR '98*. Universidad de La Plata, Argentina. Noviembre. 13 p.
- SIMS, B.G., RODRÍGUEZ, F., CÉSPEDES, E. y ESPINOZA, T. (1999). La interacción entre la conservación de suelo y agua en laderas con la tracción animal: experiencias en Bolivia. Cochabamba, Bolivia. *III Encuentro Internacional de la Red Latinoamericana de Tracción Animal (RELATA)*. pp 14-27.
- SIMS, B.G. y RODRÍGUEZ V., F. (2000). Estrategias de producción de forraje en compensación al control de malezas. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 77-83.
- SIMS, B.G., ELLIS-JONES, J. and TWOMLOW, S. (2000). Barreras vivas y otras estructuras para el control de erosión. Cochabamba Bolivia. *Curso de siembra directa en pequeñas propiedades*. 2-4 de mayo. CIMMYT. 10p.
- SIMS, B.G., DIJKMAN, J. y ZAMBRANA, L. (2000). Logros del proyecto de mejoramiento de tracción animal 1997-2000. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 13-38.
- SIMS, B.G., ROMNEY, D. y RODRÍGUEZ, F. (2000). La importancia de las barreras vivas en los sistemas agropecuarios de los valles. Cochabamba, Bolivia. Taller sobre el incremento de productividad en pequeñas propiedades con sistemas mixtos. CIMMYT y ILRI. 11p.
- SIMS, B.G., DIJKMAN, J y ZAMBRANA, L. (2001). Vista panorámica del Proyecto de Mejoramiento de Tracción Animal. In: Vladimir Plata y Angela Rojas (Eds) *Memorias II Taller Nacional de Planificación de PROMETA*. Cochabamba, Bolivia. PROMETA-CIFEMA-UMSS. pp 4-30.
- STARKEY, P. (1999). La importancia de la tracción animal a nivel mundial y sus implicaciones para Bolivia. In: *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 93-96.
- TORREJÓN, P. (1999a). Construcción y evaluación de una carreta para yunta de bueyes. *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 17-22.
- TORREJÓN M., S. (2000). Experiencias en difusión y comercialización de implementos alternativos para tracción animal.. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 111-116.
- VACA, E. y LEIVA V. (2000). Comparación entre fármacos veterinarios y fitofármacos en animales de tracción. Cochabamba, Bolivia. *II Seminario - Taller de PROMETA, UMSS*. pp 55-62.

- VELASCO, J. y RODRÍGUEZ, M. (1999). Establecimiento de praderas con mezcla de gramíneas y leguminosas, en la zona de Morochata, Cochabamba, Bolivia. *I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 23-28.
- VENTO-TIELVES, R. (1999). La experiencia cubana en el programa de tracción animal para la mecanización agropecuaria. *In: I Taller Internacional de PROMETA, UMSS*. Cochabamba, Bolivia. Proyecto de Mejoramiento de Tracción Animal. pp 79-91.
- WALL, P., CAMPERO, M, CALLE C. y SAN MARTÍN, R. (1999). Experiencias con la cobertura con rastrojos y la siembra directa en los valles interandinos de Bolivia. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 111-116.
- ZAMBRANA, L., SIMS, B.G. y FLORES, R. (1999). Los sistemas de tracción en los valles interandinos: la visión del Proyecto PROMETA. Cochabamba, Bolivia. *Taller sobre los principales sistemas de producción del ganado bovino en Bolivia*. UNIVEP. 11p.
- ZAMBRANA, L. y ANTEZANA, J.C. (1999b). Diversificación de animales de trabajo en la agricultura: desarrollo de arneses y aperos para equinos. Cochabamba, Bolivia. *III Encuentro Internacional de la Red Latinoamericana de Tracción Animal (RELATA)*. pp 35-38.
- ZAMBRANA, L., SIMS, B. y FLORES, R. (1999). Los sistemas de tracción en los valles interandinos: la visión del proyecto PROMETA. *In: Memorias del III Encuentro Latinoamericano de Tracción Animal*. PROMETA, Cochabamba, Bolivia. 8-12 noviembre. pp 89-97.

Proceedings

- SÁNCHEZ-MOLERO, J. (Ed). (1999). Proyecto de mejoramiento de tracción animal. I taller internacional de PROMETA, UMSS, Cochabamba, Bolivia. 3-5 de febrero de 1999. Silsoe, RU. Silsoe Research Institute Informe IDG/99/6. 146 p.
- PROMETA. 1999b. Memorias. III Encuentro Latinoamericano de Tracción Animal. Cochabamba, Bolivia. 8 al 12 de noviembre de 1999. PROMETA, CIFEMA, UMSS. 199 p.
- PROMETA. 1999c. Informe del seminario. III Encuentro latinoamericano de tracción animal. Cochabamba, Bolivia. 8 al 12 de noviembre de 1999. PROMETA, CIFEMA, UMSS. 42 p. + Anexos.
- PROMETA. 2000b. Memorias. II seminario-taller del proyecto de mejoramiento de Tracción Animal. Cochabamba, Bolivia. 9-11 de agosto. PROMETA, CIFEMA, UMSS. pp 197.
- PLATA, V. y ROJAS, A. (2001). Memorias II Taller Nacional de Planificación de PROMETA. 17-18 de mayo de 2001. PROMETA, CIFEMA, UMSS. pp 88.

Working documents

- FLORES, R. (2001). Documento informe 4 (Curso de tracción animal 9-11 de agosto). Cochabamba, Bolivia. PROMETA. 6 pp.
- PATERSON, R. (1997). Report on a visit to Bolivia to initiate activities in an animal traction project (Cochabamba) and to carry out routine activities in a forest margin project (Santa Cruz). 18 August to 27 September 1998. Project Nos.: C1006 and A0563. Visit No: 5627 NRI, UK. No page numbering.

- PATERSON, R. (1998a). Report on a visit to Bolivia to carry out routine activities in an animal traction project (Cochabamba) and in a forest margins project (Santa Cruz). 23 January - 27 February 1998. NRI, UK. No page numbering.
- PATERSON, R. (1998b). Report on a visit to Bolivia to carry out routine activities in an animal traction project (Cochabamba) and in a forest margins project (Santa Cruz). 27 March to 2 May 1998. NRI, UK. No page numbering.
- PATERSON, R.T. (1998c). Report on a visit to Bolivia to carry out routine activities in an animal traction project (Cochabamba) and in a forest margins project (Santa Cruz) and to present a lecture on pasture improvement and management to a farmers' association (Trinidad). 8 July to August 1998. Project Nos.: C1006 and A0563. Visit No: 5627. No page numbering.
- PATERSON, R.T. (1999b). Report on a visit to Bolivia to prepare a project memorandum (Cochabamba) participation in a project workshop (Cochabamba) and to carry out routine activities in a forest margins project (Santa Cruz). 8 January to 18 February 1999. Project Nos.: C1006 and A0563. Visit No: 6043. No page numbering.
- PATERSON, R.T. (1999c). Report on a visit to Bolivia to carry out routine activities in a forest margins project (Santa Cruz, to advise on pasture sampling in an animal traction project (Cochabamba) and to prepare a project memorandum (Cochabamba). 16 April to 22 May 1999. Project Nos.: C1006 and A0563. Visit No: 6319. No page numbering.
- ROMNEY, D.L. (1999). Back-to office report on a visit to CIFEMA in Cochabamba to provide inputs to an LPP funded project, managed by SRI. NRI, Chatham. 3 p.
- SIMS, B.G. y ZAMBRANA, L (1997) . Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 1. Silsoe Research Institute IDG/97/10. 51p
- SIMS, B.G., DIJKMAN, J., PATERSON, R., ROMNEY, D., y ZAMBRANA, L (1997). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 2. Silsoe Research Institute IDG/97/14. 101p.
- SIMS, B.G. (1997). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 3. Silsoe Research Institute IDG/97/23. 78p.
- SIMS, B.G., DIJKMAN, J., PATERSON, R. (1998). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 4. Silsoe Research Institute IDG/98/4. 169p.
- SIMS, B.G., DIJKMAN, J.D., ROMNEY, L, PATERSON, R. (1998). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 5. Silsoe Research Institute IDG/98/20. 124p.
- SIMS, B.G. (1998). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 6. Silsoe Research Institute IDG/98/28. 43p.
- SIMS, B.G. (1999a). Mejoramiento de manejo y uso de animales de trabajo en los sistemas agropecuarios de los valles inter-andinos de Bolivia. Documento de Trabajo 6. Silsoe Research Institute IDG/99/5. 55p.

- SIMS, B.G. (1999b). PROLADE, PROMETA, PROMMASEL, OXFEEED. Documento de Trabajo Combinado 1. Silsoe Research Institute IDG/99/17. 190p.
- SIMS, B.G. (1999c). PROLADE, PROMETA, PROMMASEL. Documento de Trabajo Combinado 2. Silsoe Research Institute IDG/00/5. 24p.
- SIMS, B.G. (2000a). PROLADE, PROFOCE, PROMETA, PROMMASEL, OXFEEED. Documento de Trabajo Combinado 3. Silsoe Research Institute IDG/00/9. 42p.
- SIMS, B.G. (2000b). PROFOCE, PROMETA, PROMMASEL, OXFEEED, PROLADE. Documento de Trabajo Combinado 4. Silsoe Research Institute IDG/00/14. 29p.
- SIMS, B.G. (2000c). PROFOCE, PROMETA, PROMMASEL, OXFEEED, PROLADE. Documento de Trabajo Combinado 5. Silsoe Research Institute IDG/00/17. pp 51.
- SIMS, B.G. (2001a). PROFOCE, PROMETA, PROMMASEL, OXFEEED, PROLADE, PROAMP. Documento de Trabajo Combinado 6. Silsoe Research Institute IDG/01/02. pp 33.
- SIMS, B.G. (2001b). PROFOCE, PROMETA, PROMMASEL, OXFEEED, PROLADE, PROAMP. Documento de Trabajo Combinado 7. Silsoe Research Institute IDG/01/04. pp 32.
- SIMS, B.G. (2001c). PROMETA, PROMMASEL, PROAMP. Documento de Trabajo Combinado 8. Silsoe Research Institute IDG/01/16. pp 38.
- SIMS, B.G. (2001d). PROMETA, PROMMASEL, PROAMP. Documento de Trabajo Combinado 9. Silsoe Research Institute IDG/01/xx. pp xx. In preparation, October 2001.

Technical reports

- ARANDIA, J. (1999). Investigación en las necesidades de intervención para servicios en manejo, cría y comercialización, en animales de trabajo en la provincia Campero del departamento de Cochabamba. Cochabamba, Bolivia. Prometa. 37 p.
- BENTLEY, J. (1998a). Informe del estudio de impacto socioeconómico. Primer borrador. Proyecto PROMETA. 23 p. DO NOT CITE.
- BENTLEY, J. (1998b). Case study report: R6970. Improved management and use of draft animals in the Andean Hill-farming Systems of Bolivia. Report for Pat Norris, Reading University 26p.
- DE ROOVER, P. (1997). Requirements for and supply of sustainable animal health services for six communities east, south and west of Cochabamba. Silsoe, UK., Silsoe Research Institute report IDG/98/14. 32 p + annexes.
- FLORES, R (2001). Evaluación de sistemas de captación de agua de lluvia “in situ” con tracción animal. PROMETA. Cochabamba, Bolivia. pp 12. Drafted September 2001.
- FLORES, R. and MAMANI, J. (2001) Comparación de costo y rendimiento de yugos individuales en labores culturales. PROMETA. Cochabamba, Bolivia. pp 12. Drafted September 2001.
- FLORES , R. and AGUILAR, A. (2001). Nivelador de tierras para tracción animal. PROMETA. Cochabamba, Bolivia. pp 4.
- INNS, F. (1998b). Report on a visit to CIFEMA (Centro de Investigación, Formación y Extensión en Mecanización Agrícola), Cochabamba, Bolivia. 12-23 January 1998. Silsoe, UK. Silsoe Research Institute IDG/98/7. 41p.

- INNS, F. (1999). Report on a visit to CIFEMA -PROMETA. Centro de Investigación, Formación y Extensión en Mecanización Agrícola and Proyecto Mejoramiento Tracción Animal, Cochabamba, Bolivia. 24 October - 14 November 1998. Silsoe, UK. Silsoe Research Institute IDG/99/1. 32 p + Annexes.
- INNS, F. (2000). Report on a visit to CIFEMA -PROMETA. Centro de Investigación, Formación y Extensión en Mecanización Agrícola and Proyecto Mejoramiento Tracción Animal, Cochabamba, Bolivia. 24 January - 11 February. Silsoe, UK. Silsoe Research Institute IDG/00/10. 47 p.
- INNS, F. (2001). Reporte sobre la visita a PROMETA-CIFEMA. Proyecto Mejoramiento Tracción Animal. Centro de Investigación, Formación y Extensión en Mecanización Agrícola. Silsoe Research Institute. Report IDG/01/11. pp 17. English and Spanish
- ROMÁN, M.A. (2000a). Impacto socioeconómico del proyecto mejoramiento tracción animal en el valle de Cochabamba. Cochabamba. Prometa. 24p.
- SHAW, A. and SIBANDA, L. (2000). Evaluation of selected livestock research themes. Prepared for DFID by Landell-Mills Ltd. 3p.
- STARKEY, P. (1998). Desarrollando tecnologías de tracción animal en Bolivia. Informe de revisión a mediano plazo del Proyecto de Mejoramiento de Tracción Animal (PROMETA) llevado a cabo en Cochabamba, Bolivia del 12 al 24 de octubre de 1998. (Trad. Joaquina Sánchez-Molero Fernández) Universidad de Reading, R.U. 45 p
Also in English: Developing animal traction technologies in Bolivia.
- VILLENA, P. (2000). Evaluación técnica agronómica del arado coutrier y el arado cincel de aletas. Cochabamba, Bolivia. Proyecto Prometa. 18 p + Anexos.
- PLATA, V. (2001a). Impacto socioeconómico de la tecnología PROMETA en Morochata. Cochabamba. Proyecto Mejoramiento de Tracción Animal. 13 pp.
- PLATA, V. (2001b). Diseño y evaluación de establos para animales de trabajo en los valles interandinos de Cochabamba. . PROMETA. Cochabamba, Bolivia. 21p + Anexos.
- PLATA, V. (2001c). Estudio de la calidad del forraje avena como efecto de manejo, tipo y tiempo de almacenamiento. PROMETA. Cochabamba, Bolivia. pp 32.

Theses

- AGUILAR-COLMENARES, A.R. (2000). Construcción y Evaluación de tres prototipos de niveladoras para tracción animal (yunta de bueyes). Cochabamba, Bolivia. Universidad Mayor de San Simón. Escuela Técnica Superior de Agronomía “Dr Jorge Trigo Andía”. Pasantía para obtener el título de Técnico Superior Agrónomo. **En preparación**
- ANTEZANA-COCA, J.C. (1999b). Diversificación de animales de trabajo en la agricultura: desarrollo de arneses y aperos para equinos. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas.” Tesis de grado de Ingeniero Agrónomo. 96 p.
- CALLE-MAMANI, M. (2000). Efecto de la suplementación de minerales y desparasitación en animales de trabajo. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas”. Carrera de Veterinaria y Zootécnica. Tesis de grado para obtener el título de Médico Veterinario Zootecnista. pp 79 + Anexos.

- CÁRDENAS-NOGALES, W. (2001). Estudio comparativo de tres especies de animales de tracción (buey, caballo y asno) en el cultivo de maíz. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas." Tesis de grado de Ingeniero Agrónomo. pp 83.
- CÉSPEDES C., J.C. (1999c). Evaluación de cuatro sistemas de labranza con implementos de tracción animal en el cultivo de papa. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. 60 p + Anexos.
- COPA-CORTÉZ, V. (2001). Monitoreo de sistemas de alimentación existente en animales de trabajo en los valles interandinos de Bolivia. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas." Tesis de grado de Ingeniero Agrónomo. pp 78 + Anexos.
- CRESPO-ZAMBRANA, R.G. (2001). Adaptación y evaluación de escardadoras para tracción equina en sistemas agrícolas de ladera. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. pp 78 + Anexos.
- LEIVA, V. (2001). Efectos comparativos entre antiparasitarios comerciales y desparasitantes naturales en animales de tracción en la provincia Tiraque y Morochata. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Carrera de Veterinaria y Zootécnica. Tesis de grado para obtener el título de Médico Veterinario Zootecnista. Final draft, September 2001.
- MARTÍNEZ, R. (2001). Diseño y construcción de una sembradora de granos para tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón. Escuela Técnica Superior de Agromía "Dr Jorge Trigo Andía". Pasantía para obtener el título de Técnico Superior Agrónomo. pp 54 +Anexos.
- NINA-MARTINEZ, S. (1999b). Fertilización nitrogenada y asociación con veza común en el rendimiento de avena, cebada y triticale para forraje en Morochata y Tiraque, Cochabamba, Bolivia. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. 52 p. + Anexos.
- QUINTEROS-TORRICO, W. (2001). Impacto agro-socio-económico de la tecnología CIFEMA-PROMETA de labores agrícolas (Estudio de caso en dos comunidades Andinas del Departamento de Cochabamba). Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. Drafted September 2001.
- QUIROZ-ESCOBAR, O. (2000). Diseño, construcción y evaluación de un arado reversible para tracción equina en sistemas agrícolas de ladera. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. pp 61 +Anexos.
- RODRÍGUEZ-CHÁVEZ, M.C. (1999b). Establecimiento de praderas con mezcla de gramíneas y leguminosas en la zona de Morochata, Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias "Martín Cárdenas". Tesis de grado de Ingeniero Agrónomo. 84 p.

- SÁNCHEZ-UZEDA, J.C. (2000b). Diseño, construcción y evaluación de una carreta para tracción equina. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas”. Tesis de grado de Ingeniero Agrónomo. pp 93 + Anexos.
- TORREJÓN-SÁNCHEZ, P.L. (1999b). Construcción y evaluación de una carreta para yunta de bueyes. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas”. Tesis de grado de Ingeniero Agrónomo. 59 p. + Anexos.
- VILLENA CONDORI, P. (2000). Evaluación y validación participativa del arado cincel como alternativa de conservación de la humedad del suelo en terrenos de ladera. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas”. Tesis de grado de Ingeniero Agrónomo. pp 99 + Anexos.
- CALLISAYA-ROJAS, A. (2000). Construcción y evaluación de una sembradora para trigo con tracción animal. Cochabamba, Bolivia. Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias “Martín Cárdenas”. Tesis de grado de Ingeniero Agrónomo. First draft under revision with CIMMYT, September 2001.

Collaborative agreements signed and implemented by the project

- Convenio de cooperación inter-institucional entre la ETSA, el Proyecto Laderas y el Proyecto Tracción Animal – CIFEMA, 1997 – 1999.
- Convenio inter-institucional que se suscribe entre el Proyecto Tracción Animal – CIFEMA y la Asociación de Servicios Artesanales y Rurales - 1998.
- Convenio de cooperación inter-institucional entre el Proyecto Laderas de la Facultad de Ciencias Agrícolas y Pecuarias (PL-FCAyP) y el Proyecto Tracción Animal – CIFEMA – 1997.
- Convenio de cooperación entre la Universidad Mayor de San Simón, a través de la Facultad de Ciencias Agrícolas y Pecuarias y la Honorable Municipalidad de Morochata, Provincia Ayopaya del Departamento de Cochabamba – 1997-1999.
- Convenio inter-institucional entre la Universidad Mayor, Real y Pontificia de San Francisco Xavier de Chuquisaca y el Proyecto Tracción Animal – CIFEMA 1999.
- Convenio inter-institucional entre a Escuela René Barrientos de Piusilla, el Grupo CIAL y el Proyecto de Mejoramiento Tracción Animal – 1997-1999
- Convenio Inter-institucional de ejecución y prestación de servicios entre el Proyecto Laderas – UMSS, Proyecto de Mejoramiento de Tracción Animal y el Centro de Investigación y Promoción del Campesinado – 1998.
- Adendum entre PROMMASEL y PROMETA, 16/09/99.
- Convenio entre The University of Edinburgh, Old College, South Bridge, Edinburgh EH8 9YL and PROMETA (Proyecto Mejoramiento Tracción Animal), Centro de Investigación, Formación y Extensión en Mecanización Agrícola (CIFEMA), 2 de junio 1999.
- VISIÓN MUNDIAL: Convenio inter-institucional de cooperación, para la generación y transferencia de tecnología en Tracción Animal, 1998.
- PROINPA: Convenio para trabajos conjuntos en sistemas de producción, 1998.
- CIMMYT: Convenio para el desarrollo de un prototipo de sembradora de siembra directa y en el fondo del surco, 1999.
- PROTRIGO: Convenio en el desarrollo de un prototipo de arado para captación de agua in situ, 1999.
- CCM: Convenio inter-institucional para el desarrollo de una sembradora de granos para tracción animal, 1999.

CONTRIBUTION OF OUTPUTS

The various outputs have contributed to meeting the DFID research goal in the following manner:

- (i) Recommendations have been developed for the cultivation, use and conservation of fodder and the sowing of pastures on fallow land. Paravets have been trained in the communities and guidelines for work animal parasite control developed. Various animal health and nutrition courses have been given by PROMETA both at community and university level. Animal use has been diversified through the development of appropriate equipment. Different housing options are currently in the process of a participatory evaluation.
- (ii) Tillage and rural transport equipment and harnesses for diversifying the use of equines have been developed, tested and evaluated in close collaboration with the communities. Many of these tillage and rural transport tools and harnesses are now being manufactured commercially and sold. The only limitation to greater adoption of the developed technologies is the CIFEMA factory capacity.
- (iii) The link between R6970 and R6621 (Soil and water conservation on Bolivian hillsides) has led to synergy in the development of vegetative conservation measures, which also serve as work animal forage banks in the dry season. The establishment of vegetative contour barriers results in modifications of animal use and PROMETA has developed equipment (reversible ploughs, vertical tillage implements) for single animals (equines and bovines) for the formation of terraces. In addition, various vegetative species for an improved fallow has been investigated and are potentially, apart from providing additional fodder, erosion control measures.

In a relatively short time the Project has developed a range of technologies and strategies for the improved management of working animals. Not only has there been a clear demonstration of the desire for continued participation by the farmers in the target communities, but also the Project has awoken widespread interest both nationally (principally from NGOs via the Bolivian Animal Traction Network -RENTA- led by PROMETA) and internationally through the Latin American Animal Traction Network (RELATA).

Project outputs are disseminated to intermediate users through members of RENTA (NGOs, Universities, retailers, rural development projects); and directly to farmers through the Project's participation in its communities, and through CIFEMA's extension and distribution network. Annual PROMETA workshops have served as a major platform for output dissemination at national and international levels.

The current Project is achieving and exceeding its goals, and the one-year extension has helped to ensure effective dissemination to the poorest sectors of the inter-Andean valleys' agricultural communities.

ANNEX 1. LOGICAL FRAMEWORK OF PROJECT R6970

Improved management and use of working animals in the Andean hill farming systems of Bolivia.

	Measurable Indicators	Means of Verification	Important Assumptions
<p>Goal: Performance of livestock (including draught animals) in forest-agriculture interface and hillside (crop/livestock or livestock) production systems improved.</p>	<p>By 2005 in nominated target areas where primary demand exists: - Productivity of ruminant livestock owned by smallholder farmers/herders increased by 20%. - Area cultivated per livestock unit increased by 15%. - Total crop yield in areas cultivated by livestock increased by 10%.</p>	<p>Reports of target institutions. National production statistics. Evaluation by livestock production programme. Research programme reports. Monitoring against baseline data</p>	
<p>Purpose: In one hillside and one forest-agriculture interface crop/livestock system, energy balance of draught animals in traditional work assessed in relation to species, animal size and physiological status, environmental variability, soil type and structure and machinery options, and appropriate feeding strategies developed and promoted.</p> <p>(Improve the exploitation of animal power in hillside production systems)</p>	<p>Systems tested, validated and adopted by 10% of farmers in the target communities by 2000.</p>	<p>Dissemination statistics. National production statistics. Research programme reports. Monitoring against baseline data.</p>	<p>Target institutions invest resources in uptake and application of research products in hillside agriculture systems.</p> <p>Enabling environment (policies, institutions, markets, incentives) for widespread adoption of new technologies and strategies exists.</p> <p>Complementary research results to achieve project goal are available.</p>
<p>Outputs: 1. Recommendations for improved management of working animals (feed resources, nutrition, use, health, housing) developed, validated and disseminated 2. Equipment for working animals in hillside environments developed, validated and disseminated 3. Recommendations for improved management for soil and water conservation developed, validated and disseminated</p>	<p>1. 1 Recommendations for improved work animal management produced (from April 1998). 1.2 Recommendations for improved work animal management evaluated and disseminated (from April 1999) 2.1 At least 5 pieces of equipment for working animals developed (from April 1998). 2.2 At least 5 pieces of equipment for working animals evaluated and disseminated (from April 1999) 3.1 Recommendations for improved soil and water management produced (from April 1998). 3.2 Recommendations for improved soil and water management evaluated and disseminated (from April 1999).</p>	<p>Periodic project reports. Participatory evaluation reports. Workshop proceedings Project final report Scientific papers.</p>	<p>Results of the study are widely applicable to other hillside systems.</p> <p>Close collaboration with existing complementary research projects and local institutions.</p> <p>Funds for work proposed are made available at the start of FY 1997/98.</p>

	Measurable Indicators	Means of Verification	Important Assumptions
<p>Activities:</p> <p>1.1 Participatory selection of appropriate technical solutions for:</p> <p> 1.1.1 animal health</p> <p> 1.1.2 fodder production, conservation and utilization.</p> <p> 1.1.3 land-use technology for feed production including live barriers/fences, hedgerow intercropping and improved fallows</p> <p> 1.1.4 animal housing</p> <p> 1.1.5 diversification of animal use</p> <p>1.2 Participatory evaluation of selected technologies for:</p> <p> 1.2.1 fodder production, conservation and utilization</p> <p> 1.2.2 land-use technology for feed production including live barriers/fences, hedgerow intercropping and improved fallows</p> <p> 1.2.3 animal housing</p> <p> 1.2.4 diversification of animal use</p> <p>2.1 Participatory selection of appropriate draught animal equipment for transport, soil cultivation, seeding, weeding and harvesting</p> <p>2.2 Adaptation, design, construction and participatory evaluation of implements for working animals</p> <p>3.1. Participatory selection of appropriate conservation methodologies for soil and water conservation:</p> <p> 3.1.1 soil cultivation equipment</p> <p> 3.1.2 soil conservation practices linked with fodder production</p> <p>3.2 Participatory evaluation of equipment and soil and water conservation practices for hillsides</p> <p>4.1 Dissemination of project results to farmers and intermediate users through workshops, field days, exchange visits and use of existing mass media</p> <p>4.2 Publication of project results as technical reports and journal articles</p>	<p>Inputs/Resources</p> <p>Project budget</p> <p>Staff costs 128,090</p> <p>Travel and subsistence 41,044</p> <p>Running costs 82,538</p> <p>TOTAL 251,672</p>	<p>Periodic project reports.</p> <p>Participatory evaluation reports.</p> <p>Workshop proceedings.</p> <p>Project final report.</p> <p>Scientific papers.</p>	

ANNEX 2. LOGICAL FRAMEWORK OF PROJECT R6970 EXTENSION (2000-2001)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Goal			
Livestock performance improved (including working animals) in the production systems (crops and livestock) at the agriculture forest interface and on hillsides.	To be completed by Programme Manager	To be completed by Programme Manager	To be completed by Programme Manager
Purpose			
In one interface of hillsides systems and one of forest / agriculture, evaluate the energy balance of working animals in relation to species, size and physiological condition, environmental variability, class and structure of soil, machinery options and appropriate feeding strategies. Develop and promote appropriate strategies.	To be completed by Programme Manager	To be completed by Programme Manager	To be completed by Programme Manager
Outputs			
<p>1. Impact study of PROMETA developed technologies and recommendations.</p> <p>2. Strengthened extension infrastructure.</p> <p>3. A new proposal for participatory research and development.</p> <p>4. Continued participatory R&D</p>	<p>Impact study completed.</p> <p>2.1. RENTA, RELATA and other networks participating in PROMETA.</p> <p>3 community workshops held.</p> <p>Stakeholder workshop held.</p> <p>Continuing participatory R&D in the 6 Project communities.</p>	<p>Report and recommendations of impact study.</p> <p>Proceedings of seminars and workshops, exchange visits, joint publications (technical and extension).</p> <p>Reports of rural training courses.</p> <p>Inter-institutional accords established.</p> <p>Training and extension bulletins and videos produced.</p> <p>Workshop reports.</p> <p>Project memorandum.</p> <p>Theses.</p> <p>Project reports.</p>	<p>Rural communities impart the required information on impact.</p> <p>Project outputs are widely applicable to the Andean hillside systems.</p> <p>Research and rural extension institutions continue to collaborate strongly.</p> <p>Communities and stakeholders participate and demonstrate strong grounds for future participatory R&D.</p> <p>The only assumption will be that of continued funding.</p>

Activities	Inputs	Means of Verification	Important Assumptions
<p>1.1. Contract a socio-economist. The socio-economist will work closely with the present PROMETA team to elaborate a study plan in the Project's regions of influence.</p> <p>1.2. Regional surveys in Chuquisaca, PotosPand Tarija commissioned.</p>	<p>Total Budget here £87 005</p>	<p>Socio economist conducts impact study. Report and recommendations produced</p> <p>Regional impact reports produced</p>	
<p>2.1. Forge closer links for collaboration with RENTA, RELATA and other national and international animal traction networks.</p> <p>2.2. Hosting the third annual PROMETA workshop</p> <p>2.3. Formulation and delivery of rural courses on PROMETA technologies.</p> <p>2.4. Establishment of inter-institutional R&D and training accords.</p> <p>2.5. Production of technical bulletins and videos.</p>		<p>Evidence of continued development of strong inter-institutional links (workshops, publications, exchange visits)</p> <p>Proceedings of III PROMETA workshop.</p> <p>Courses prepared and delivered.</p> <p>Technical bulletins and videos produced.</p>	
<p>3.1. Preparation of new project proposal will be based on the impact study. Based on information gathered through three community workshops.</p> <p>3.2. Finalization of the new project through a participatory shareholder workshop.</p>		<p>Project Memorandum produced.</p>	
<p>4.1 Continued technology development as demanded by the Project's farming communities. as described in the Project Memorandum for R6970. The specific development projects will emerge in the course of next year's programme.</p>		<p>New technologies produced, and adopted.</p>	

ANNEX 3. LOGICAL FRAMEWORK OF NEW PROJECT PROPOSAL

Narrative Summary	Indicators of Achievement	Means of Verification	Important Assumptions
Goal			
Benefits for poor people generated by the application of new knowledge on the improved performance of livestock in forest agriculture interface / hillside production systems			
Purpose			
<p>- Strategies to sustainably improve the production and productivity of livestock of relevance to the resource-poor people in forest agriculture / hillside communities, developed and validated.</p> <p>- Strategies to improve the production and productivity of livestock maintained by resource poor people in forest-agriculture / hillside communities, promoted and disseminated.</p>			<p>Livestock is a valid entry-point for poverty alleviation</p> <p>Valid relationship between awareness creation through better information and better policies</p>
Outputs			
<p>1. Participatory research - Low-cost animal-drawn and pack transport technologies.</p> <p>- Resource-use optimization strategies for livestock-dependent poor in forest agriculture / hillside communities.</p> <p>2. Dissemination Methodologies, mechanisms, media products and advisory support tools for efficient and effective agricultural knowledge transfer in poor rural communities.</p> <p>3. Scaling-up - Policy and institutional changes (at different levels) that facilitate and stimulate widespread diffusion and adoption of research outputs by resource poor people in forest agriculture / hillside communities.</p>	<p><i>Low-cost animal-drawn and pack transport technologies used by livestock dependent poor in forest agriculture / hillside communities.</i></p> <p>Resource-use optimization strategies in use by livestock-dependent poor in forest agriculture / hillside communities.</p> <p>Methodologies, mechanisms, media products and advisory support tools identified, analysed, developed and used for efficient and effective agricultural knowledge transfer in poor rural communities</p> <p>Policy and institutional changes (at different levels) that facilitate and stimulate widespread diffusion and adoption of research outputs by resource poor people in forest agriculture / hillside communities, formulated and implemented.</p>	<p>Periodic project reports. Project final report. Scientific papers.</p>	<p>Close collaboration with existing complementary research projects and local organizations.</p> <p>Funds for proposed work are made available at the start of FY.</p>

Activities	Inputs	Means of Verification	Important Assumptions
<p>1. Participatory research - Participatory research to identify, develop and evaluate low-cost animal-drawn and pack transport technologies.</p> <p>- Participatory research to identify and evaluate different resource-use optimization strategies for livestock-dependent poor.</p>	<p>Inputs/Resources</p> <p>Project Budget over three years:</p> <p>Staff costs £ 78,813</p> <p>Travel and subsistence £ 36,253</p> <p>Running costs £ 132,036</p> <p>Total £247,102</p>	<p>Periodic project reports. Project final report.</p> <p>Scientific papers.</p>	<p>Continuity of local collaborating staff.</p> <p>Security situation in the region remains unchanged.</p>
<p>2. Dissemination - Identification of current knowledge, attitudes and practices and current or potential information channels and mechanisms.</p> <p>- Identification and analysis of information needs of different end-users in the context of poverty reduction, household food security, environmental protection and farming systems' dynamics.</p> <p>- Identification, development and testing of appropriate mechanisms, media products and advisory support tools.</p>			
<p>3. Scaling-up - Comprehensive analysis of external and internal driving forces, mechanisms, policies and institutional factors affecting the decision-making process and their impact on poor people's livelihoods strategies.</p> <p>- Information and decision-support needs' assessment of the actors that influence the policies and institutions that affect poor people's livestock-dependent livelihoods.</p> <p>- Elaboration and dissemination of the identified information and knowledge tools that influence the policies and institutions that affect poor people's livestock-dependent livelihoods.</p>			