

CIFEMA

*Centro de Investigación, Formación y Extensión en Mecanización Agrícola
Cochabamba, Bolivia*



Developing animal traction technologies in Bolivia

Report of the mid-term review of
Proyecto Mejoramiento Tracción Animal - PROMETA
undertaken in Cochabamba, Bolivia from 12-24 October 1998

by

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Cover photographs © Paul Starkey

Top left: Pack donkeys, Boquerón Kasa (Tiraque)

Top right: Loading manure on pack horse, Piusilla

Bottom left: Horse pulling 'high-lift' implement with wooden traces, Capinota

Bottom right: Oxen plowing CIFEMA implement, Capinota

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Summary

PROMETA is a DFID-funded research Project. It aims to improve livestock productivity, by selecting and evaluating technologies relating to animal traction equipment, animal health and management, and soil and water conservation systems. A small team based in CIFEMA in Cochabamba implements the programme, with technical assistance from SRI, NRI, FAO and local consultants.

PROMETA has a participative methodology for identifying constraints with farmers and evaluating solutions. The Project works closely with other organisations, with synergistic mutual benefits. This collaborative approach has allowed the Project to build on existing technologies and develop them with partners, including farmers, CIFEMA, UMSS, ASAR, PROINPA, FAO Fertisuelos and external experts. Credit for the Project output technologies is shared with these collaborators. This approach has enabled rapid achievements, with 'built-in' uptake paths with good prospects for sustained impact.

PROMETA (with other organisations) is now evaluating several technologies including equid plows, a high-lift harnessing system, a ripper tine and animal-drawn carts with brakes. It is too early to predict adoption patterns, but the Project should achieve its equipment targets. This is encouraging, given the short life of the Project and its modest budget. The Project will put greater emphasis on soil and water conservation technologies, including bunding and terracing, tine tillage and use of reversible plows.

Animal-related technologies being evaluated by farmers include pastures, fodder crops, horse tillage and stables. Sown pastures appear popular and there is interest in horse plowing. Purchasing calves from distant markets can cause health problems. Research is planned on the efficacy of indigenous vermicides. Progress towards targets is good, but verification will take several more farming cycles.

PROMETA has supported eight student research theses and eight consultancy reports have been produced. Relevant work will be summarised in leaflets like the attractive general one produced. Five international conference papers have been prepared. PROMETA staff have provided informal training to collaborating farmers and partners and have influenced approaches within the agricultural faculty. In future, there will be less emphasis on student managed on-farm trials that can inconvenience farmers. It is hoped the university will recognise the worth of participative research, even if largely qualitative.

PROMETA has achieved a great deal on a limited budget by collaborating with other stakeholders. It is recommended that PROMETA continue its present programme and methodology with some minor modifications. Overall, there should be greater emphasis on the social and economic implications of the technologies, including gender issues. These are crucial in determining adoption and benefits.

Animal transport can assist poverty elimination, livestock productivity and development. CIFEMA should ensure a supply of affordable carts and stimulate the creation of a critical mass of users in appropriate communities. In many areas, pack animals are more appropriate, but existing packing techniques cause sores. The Project should start participatory evaluation of simple pack-saddles.

There is potential for greater use of working equids. The potential for working cows should be studied, with reference to experience in the altiplano. Crop residues and dual-purpose crops should be given more attention. Work on buffaloes is not a priority, but Latin American experience should be reviewed.

As PROMETA is a temporary structure, there is need for a durable dissemination pathway for Project ideas, experiences and outputs. One option is a broadly-based national animal traction network, initially coordinated by CIFEMA. PROMETA should stimulate its creation by inviting a wide range of organisations to its 1999 national workshop. PROMETA/CIFEMA should host an international workshop in late 1999, in collaboration with the RELATA international network. These networks should provide valuable information and maximise the impact of project experiences.

It is too early for the Project to have had an impact on livestock productivity and poverty elimination, there should be long-term benefits. Several envisaged Project outputs, including implements, transport technologies and conservation systems should have relevance in other countries. Constraints to adoption may include technology supply systems, extension and credit. The resources of many Bolivian organisations and agencies could be harnessed through a dynamic animal traction network.

In conclusion, PROMETA has achieved a great deal in a short time with limited resources. It is undertaking most envisaged activities and on its way to achieving envisaged output recommendations relating to animals, equipment and conservation systems. The Project is a good example of what can be achieved by dedicated staff, inter-institutional cooperation and participatory processes. It is too early for Project actions to have had significant impacts on target communities. It is reasonable to envisage the Project will have a long-term and sustainable impact on crop and livestock productivity and rural livelihoods. The Project, and its sponsors, should be preparing for a second phase.

Introduction and acknowledgements

Project context

PROMETA is a research Project funded by the British Department for International Development (DFID). It is working in the Andean valleys and hill-farming systems of Cochabamba, Bolivia. Its aim is to improve livestock productivity, by selecting and evaluating technologies that relate to animal health and management, animal traction equipment and systems for soil and water conservation.

Following diagnostic rural appraisal surveys and planning in 1996, the project started in 1997 and is due to run until the year 2000. A small Bolivian team implements the project within the context of CIFEMA (Centro de Investigación, Formación y Extensión en Mecanización Agrícola), the agricultural engineering centre of the Universidad Mayor de San Simón (UMSS). The PROMETA implementing team receives short-term technical assistance from Silsoe Research Institute (SRI), Natural Resources International (NRI), the Food and Agriculture Organisation of the United Nations (FAO) and consultants based in Bolivia.

Mission context and objectives

This report relates to a consultancy mission of Professor Paul Starkey to Cochabamba, Bolivia from 12-29 October 1998 to undertake a mid-term review of PROMETA (Proyecto Mejoramiento Tracción Animal). He was expected to meet with the Project team and various project stakeholders (including some target communities) in order to review the achievements to date and suggest appropriate future directions for the Project, including measures to achieve greater interaction with the international network: RELATA. The consultant was asked to consider the likely impact of the project and its relevance to DFID developmental objectives in Bolivia and elsewhere. The consultant was also expected to participate in Project technical sessions and give a seminar. The full terms of reference can be found in the report annexes.

Working with various members of the project team, the consultant had contacts with over 100 relevant persons including university personnel, staff of collaborating organisations and farmers. He visited several rural communities, observed different farming systems and discussed relevant issues with men and women who were users of animal power and/or potential beneficiaries. The mission itinerary and a list of some of the persons contacted can be found in the report annexes.

As planned, the consultant also gave a University Seminar at UMSS. A summary of the issues raised is given in the annexes of this report.

Acknowledgements

The consultant would like to express his appreciation to all the people who assisted his work. Particular thanks go to the CIFEMA Director, Ing Jaime Mendoza, to the PROMETA coordinator, Ing Leonardo Zambrana and to the Silsoe Research Institute Consultant, Ing Brian Sims. The consultant would also like all the other project staff who assisted the visit, including the CIFEMA Extensionist, Ing Daniel Velasco, and the Field Technicians, Ing Rene Flores, Ing Jorge Velasco and Ing Vladimir Plata.

Great appreciation is also due to the University Authorities, particularly the Rector (Alberto Rodríguez), the Dean of the Agronomy Faculty (Ing Jaime la Torre), the Academic Director (Ing Carlos Rojas) and the Agronomy Faculty Research Director (Ing Rosario Torrico).

The DFID Livestock Production Programme contributed towards the costs of this mid-term review, and thanks are due to its Programme Manager, Dr J Irwyn Richards of Natural Resources International Ltd, Chatham, UK.

Acknowledgement is due to all the persons contacted during this review, including the project collaborators and farmers. These people provided many of the ideas and information contained in this report. To all the people who assisted the review, a warm 'thank you'.

Project objectives, structure and methodology

Project objectives and planned activities

The goal of the project is the improved performance of livestock (including draft animals) in hillside production systems. The purpose is the improved exploitation of animal power in hillside production systems through the assessment, development and promotion of appropriate strategies relating to the animals, the soil-water environment and the equipment used.

The envisaged Project outputs fall under three main categories.

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

Project activities have been planned to address these three broad areas of work (animals, equipment and soils). In each of these areas, the Project has planned participatory work with farmers, first to select suitable technologies for testing and then to assist the farmers to evaluate these technologies.

The envisaged activities involved the identification and evaluation of technologies and management systems relating to:

- Animal health and housing
- Diversification of animal use
- Fodder production, conservation and utilisation including related land-use strategies
- Equipment for transport, soil cultivation, seeding, weeding and harvesting
- Soil and water conservation systems, related equipment and fodder-production implications.

The Project intends to disseminate its findings to farmers and others through workshops, field days, exchange visits, mass media and technical publications.

The Project Logical Framework is given in the annexes of this report.

Project structure and finance

The Project is implemented by a small Bolivian team based at CIFEMA, part of the UMSS University in Cochabamba. The Project provides the salary of its full-time Project Coordinator (Ing Leonardo Zambrana). Most other members of the Project Team are staff of CIFEMA, which also contributes the Project offices and most of the logistical and secretarial support. The operating costs of the Project Team, together with certain essential equipment, have been provided through the Project.

Some of the research work has been assigned to UMSS students as part of their thesis assignments. Such thesis studies involve quite rigorous planning and selection procedures prior to acceptance of the work by the university authorities. The modest costs of this research have been funded by the Project.

There are no full-time expatriates working on the Project, but the Bolivian team receives technical assistance from various consultants. The lead consultant, Brian Sims, of Silsoe Research Institute, has 45 workdays a year paid for by the Project. The Project has budgeted for 15 workdays per year each from an animal nutritionist and pasture agronomist from NRI. In addition, FAO has provided the services of Dr Jeroen Dijkman, an animal scientist involved in planning the Project, for ten days or more a year. Local consultant specialists have also been hired. About 60% of the annual budget of around £80,000 for three years is required to meet the salary, overhead and travel costs of the expatriate element, with the remaining budget meeting Bolivian staff costs and operating expenses. The impact of the expatriate element has been greater than would appear possible from the small number of days formally allocated to the Project. This has been partly due to the close association of other related DFID-funded projects, involving SRI and NRI, particularly the Hillside Project. These have meant that expatriate specialists (notably Brian Sims) have been in Cochabamba for longer periods of time, providing more opportunities for contacts and reducing the 'edge-effect' losses

associated with international travel. The high impact of the expatriate element has also been associated with staff dedication and good working relationships.

Project methodology

PROMETA has adopted a participative methodology for identifying constraints and evaluating potential solutions. The Project works closely with a range of other organisations. In some ways this methodology has been developed as a matter of principle, since an inclusive approach is likely to bring additional knowledge and be more sustainable in the long term. In other ways, this methodology has been forced on the Project, due to its small number of full-time personnel, modest budget and limited transport options. The Project has simply not had the resources to undertake its ambitious programme alone. The Project has been able to build on a range of existing technologies and expertise, and develop them with a range of partners (including farmers). The Project has built on (and enhanced) the experience of CIFEMA, other UMSS departments, ASAR, PROINPA, FAO Fertilisuelos and CIPCA, as well as expertise from other countries.

In some cases, the Project has provided ideas and advice to existing programmes (such as the animal-drawn cart and stable initiative funded by FAO; the seeder initiative of IBTA/CIMMYT). In other cases, the Project has taken ideas from elsewhere and tried to adapt them to local conditions (eg, the Cincel plow and the high-lift harness). The Project has also encouraged other organisations to help evaluate possible technologies (eg, implements with PROINPA; pastures with CIAL, Piusilla).

This collaborative approach has clearly been synergistic, with mutual benefits for the various partners. Various technologies have been identified and developed within the Project framework. These are clearly Project outputs, although credit for these can be shared with a range of Project collaborators.

The Project approach and methodology has enabled it to achieve a great deal in a short time. Since the Project actions are being undertaken in collaboration with several different partners, there is now a range of 'built-in' uptake paths. If the partner organisations find that the technologies being evaluated are proving popular and valuable, they will naturally wish to promote them among other farmers and communities with whom they are working. This should provide good prospects for the sustainability of Project impacts.

Project actions and achievements

Animal nutrition, management and health

PROMETA (in collaboration with other organisations) has identified several possible technologies relating to animal nutrition. Tested options have included sown pastures, fodder cereals and the use of fodder bunds (living conservation barriers on which fodder plants are grown). In 1998, farmers in several locations grew pasture plots and fodder plants. There was considerable variation in the success of establishing pastures and fodder bunds, with a wide range of influencing factors including soil conditions at planting, rainfall/irrigation, grazing pressures and the presence of effective fencing.

The sown pastures appeared quite popular in some locations (such as Piusilla), with good sample plots and a high demand for more pasture seeds from both farmers and collaborating organisations. It is too early to know whether this will prove to be an economically viable demand, but the initial reaction of farmers and farmers' groups gives some cause for optimism.

First impressions from farmers, and from those conducting the trials, are that fodder cereals seem much less attractive to farmers than do sown pastures. This is in line with experience from many other countries, where resource-poor farmers generally find single-purpose fodder crops are less attractive than dual-purpose crops, with fodder residues.

Trials to establish fodder bunds in hillside farming systems have provided quite variable results. In some locations, it was possible for the farmers to make use of grass from the bunds, while in others grass establishment was disappointingly slow. The trials are being continued, and advice is being sought of possible causes of poor production, and alternative fodder species.

Project work relating to the use of 'improved' stables has been limited to liaison with an FAO project promoting such technologies. The stables promoted use local materials. Compared to many family dwellings, they are of generous proportions and durable construction. They are presently subsidised, and so it is not clear whether present farmer appreciation will stimulate future economic demand. It is possible that a more modest design of stable would be more appropriate.

It is possible that livestock productivity could be enhanced through farm management systems that employ horses and/or donkeys for tillage. Farmers are presently evaluating the use of horses for plowing, ridging and weeding, using traditional implements and a new equid plow imported by the Project. The technology has been tried with donkeys, but farmers are not yet formally evaluating this option. For generations, oxen have been the tillage animals of choice in the Andean valleys, and farmers often express scepticism about the potential for using equids for plowing. However, both farmers and partner organisations, have shown clear interest in evaluating the use of horses. There has been less enthusiasm for using donkeys (which are smaller and so less powerful). However, donkeys are already used for tillage in parts of Bolivia, and this option may also prove appropriate in certain ecological and socio-economic circumstances. As with most of the Project trials, it is too early to predict whether the technology will be adopted, but farmer interest in the use of equids for tillage suggests that there may be a niche for this technology within the Andean valleys.

The Project has commissioned a consultancy study relating to animal health issues and constraints in the Andean valleys (de Roover, 1997). This identified a number of problems, including the importation of diseases into the valleys by animals purchased in the regional cattle market. The report pointed out the health benefits that would come if the valley populations were self-sustaining and recommended certain restrictions on animal movements. The report also highlighted the economic incentives that encourage farmers to buy young, cheap animals at market and re-sell them at a profit after some years of work. Such incentives would also come if farmers were to breed their own animals, and the Project is encouraged to consider ways of enhancing calf production in the valleys. One way of doing this would be substituting some work oxen for work cows.

Another Project activity in the field of animal health has been the training of village-based animal health assistants in association with CIPCA. Such training should contribute towards the Project goal as well as improve relationships with rural communities. Moreover, it should make it easier for the Project to undertake further investigations and technology assessments in the field of animal health.

A student research Project comparing the efficacy of indigenous and 'western' parasite control methods is being planned. This could prove very interesting if there are clear results. However, the inherent problems of small-scale, on-farm investigations, with much variation and few degrees of freedom, suggests that the outcome may well be inconclusive.

In general, progress towards Project targets relating to animal nutrition, management and health appears good, given that the Project has only been operating for less than two years. However, it seems unrealistic to expect important animal-related technologies and nutritional systems to be identified and evaluated within a three-year period. The evaluation of the various technologies by farmers and the Project will have to involve several more farming cycles.

Equipment

PROMETA (in collaboration with other organisations) has identified several types of equipment that it is currently evaluating and developing. These include, light-weight plows and ridgers suitable for use with horses and donkeys, a high-lift harnessing system, a single tine (Cincel) and animal-drawn carts with braking systems. Farmers have been interested to evaluate these on their farms.

The implement options being assessed include a very small mouldboard plow developed by Frank Inns and Alan Stokes of UK, a smaller version of the successful Arado Combinado, and a ripping tine developed by CIRAD in West Africa. All these must be considered as prototypes in Bolivian farming systems. Farmer interest in the equipment seems to be high, although it is too early to know whether this will be translated into economic demand.

The harnessing system being evaluated is the 'high-lift' system being promoted by Professor Frank Inns. There has been some academic controversy concerning the papers of Frank Inns that have

argued the case for this system. However, harnessing 'hip straps' (which are crucial to the system), have been used successfully for generations in some areas (including Mexico and the Middle East). Farmers seem willing to accept the harnessing system at face value. They may well modify it at a later date. The promoter of the harnessing system assumes that farmers will accept a high angle of pull, and the associated implements are being designed with this in mind. However, field observations in Bolivia and general experience suggests that farmers are unlikely to maintain a specific angle of pull. (During a field demonstration, a farmer varied the angle considerably by placing the hip strap over the saddle blanket for the comfort of the horse). In such circumstances it is important that the equipment must be capable of working effectively (even if not optimally) under a range of pull angles.

The Project is evaluating an alternative harnessing system, based on a traditional design. This uses wooden poles as rigid traces to pull the implement, and these can be attached to a breast-band/back-strap harness or to a collar or saddle. This system was developed on the advice of a farmer.

The Project has commissioned one student thesis on carts, which is nearing completion. This has involved some theoretical studies, the review of some literature, some needs assessment and some technology evaluation. The Project has yet to determine how to translate this study into practical recommendations. The Project has also developed a prototype braking system that is being evaluated. The carts made by CIFEMA are very expensive, by world standards. In the future, the Project, and its partner organisations, may become involved in the on-farm evaluation of cheaper carts, as discussed in a subsequent section of this report.

The on-farming testing of equipment is still at an early stage. It is common for agricultural engineers to be very optimistic at this time, assuming that farmers will go on to adopt the equipment being tested. However, such optimism needs to be balanced by objective realism, for there have been many implements world-wide that have been 'perfected yet rejected' (Starkey, 1990).

It is certainly too early to predict final adoption patterns, but there appears a reasonable probability that the Project will achieve, and perhaps even exceed, its initial equipment targets within the envisaged timeframe. This is extremely encouraging, given the short life of the Project and its modest budget. However, as with other technologies, it will take several more farming cycles for farmers to fully evaluate the implements, harnessing systems and carts.

Soil and water conservation

PROMETA (in collaboration with other organisations) has been involved in the selection and evaluation of several soil and water conservation technologies. These include bunding and terracing, tillage using a single ripper tine (Cincel) and use of reversible plows on terraces. The Project has worked closely with the DFID-funded Hillside Project in these investigations.

The Project is aware of the great importance of conservation measures, and is optimistic that the various joint investigations will lead to some clear recommendations. To date, the Project has concentrated on the evaluation of implements and the development of bunds and terraces, rather than objective measurements of soil and water losses. The Project intends to put greater emphasis on soil and water conservation activities in the coming years, with continued close collaboration with the Hillside Project and local communities. The Project considers that the achievement of its initial targets is probable, although additional time will be required for full evaluation of these technologies.

Extension, training and publications

Project emphasis, at this early stage, is on the identification and evaluation of technologies. Extension and awareness-creation of options are clearly by-products of this work, but they are not yet major objectives. As noted, the Project methodology, involving participative trials with farmers and collaboration with other organisations, provides an excellent basis for future extension work.

The Project methodology involves on-going processes of informal staff training and farmer training. This is apparent when new technology options are discussed during Project meetings, both internal and community-based. In the course of their research work and interactions with other organisations, PROMETA staff have been providing informal training services to collaborating farmers, university colleagues and other associates. The acknowledgement within parts of the agricultural faculty of the

importance of farmer-centred, participatory processes is partly due to the influence of PROMETA. This is encouraging given the more formal academic and 'top-down' approaches that prevail in many universities. Naturally there is scope for further guidance and influence. This indirect benefit of the Project could help influence the next generation of researchers and extensionists in Bolivia.

The Project has been involved in some formal training activities, including sponsoring the training of veterinary assistants, in association with CIPCA.

PROMETA has supported several students to undertake research, with eight theses currently being planned, prepared or finalised. These, together with the eight consultancy reports and working documents are intended primarily for internal Project use. The Project plans that relevant thesis work and other Project studies will be summarised in leaflets. The Project has already produced an attractive general leaflet to publicise its work. It intends to produce further subject-specific leaflets that should ensure the Project research studies are translated into specific extension advice. The leaflets should be helpful to the organisations working with farmers (community associations, NGOs, projects etc) as well as farmers themselves. The information from studies will also be published locally in national journals or workshop proceedings. This will not only give greater publicity to the findings within academic and development circles, it will also help establish the reputations of the investigators, and publicise the importance of research on animal traction.

To date, the five papers written for international audiences (mainly conferences) have been prepared by two of the expatriates (Sims and Dijkman), with national collaborators acknowledged as co-authors. Given the early stage of Project life, the papers have naturally concentrated on situation and constraint analyses and methodological processes. It is to be hoped that as the Project develops, the national experts will also achieve recognition by writing papers for an international audience, with increasing emphasis on specific Project outputs and lessons. The proposed international workshop (see subsequent section of this report) should provide valuable opportunities to share the lessons and experiences of the Project with people from many other countries in the region.

It is normal in research and development projects for most written outputs to come in the later years of Project activities. There is no reason to suppose the Project will not meet its publication targets.

National and international networking

Since PROMETA has adopted a networking approach to its work, it is in contact with a wide range of organisations around Cochabamba. PROMETA staff have participated in various meetings and workshops on topics of mutual interest, including the work of the DFID-supported Hillside Project.

There has been less international networking. Expatriate collaborators have participated in some international workshops. One staff member received training in Honduras and another in Chile.

It is suggested that Bolivian staff could benefit from further international networking. There is also scope for further national networking, leading to greater information exchange and enhanced prospects for the sustained impact of the Project. Some specific networking proposals are given below.

Future directions

Project methodology

The Project has developed a valuable methodology, highly appropriate to its purpose and the Bolivian context. There is an enthusiastic, motivated and dynamic Project team. The approach is inclusive and synergistic, seeking collaboration with other partners, influencing other organisations and implementing joint activities. The process is clearly participative, with farmers involved in the identification, selection and evaluation of technologies. The methodology has been evolving and further developments can be expected as Project experiences are reviewed.

It is important that the Project team retain an objective and self-critical approach to their activities. With any project that is identifying and promoting technologies, there is a danger that the promotion of the

encouraging technologies leads to lack of objectivity. The PROMETA team does tend to promote the virtues of their favoured technologies, and in doing so the investigators may sometimes be insufficiently sensitive to other opinions. It is absolutely essential for all involved in the Project to listen to farmers and other organisations for possible concerns or constructive feedback. The Project team must maintain their enthusiasm, but combine this with more rigorous objectivity and self-criticism.

The Project aims to evaluate and promote technologies, and naturally emphasis has been on the technologies themselves and their potential role in the farming systems of the Andean valleys. The investigation of possible technical benefits is naturally crucial to Project success, but it is also extremely important to understand the social and economic implications of the technologies. Economic and social criteria will be particularly important in determining whether the technologies being assessed will actually be adopted. It is therefore recommended that the Project pay increasing attention to social and economic issues in the coming years.

Participative research

The Project has a good record of working with farmers, farmers' groups and collaborating organisations. Its relationships with the farmers are good, and farmers opinions are solicited and taken seriously. The good relationship is in large part based on farmer expectations of benefits, and when there has been friction, this has been mainly due to the farmers feeling they were not benefiting sufficiently. Examples have been when experimental procedures did not seem particularly worthwhile for the farmers, or when other [development] organisations in the area were providing more immediate and tangible benefits. The Project has been addressing these issues through transparent discussions.

While the overall participative approach of the Project is good, there is scope for additional staff training in participatory processes. For example, it would be valuable to review logistical and conversational techniques aimed at maximising the benefits from farmer interviews and meetings.

The Project has not made a particular effort to target women as beneficiaries. As men are the main users of animal traction technologies, most of the collaborating farmers have been men. The Project should be aware of the potential for male-bias in its discussions and actions and should therefore make specific efforts to ensure that relevant gender issues are addressed in the future. Where practical, the Project should make more of an effort to involve women in its work. In all communities there are female-headed households, and there may well be issues relating to their access to animal traction technologies that the Project could usefully address. The transport of forage to animals is often a gender-related role (women are the main transporters) and the potential benefit of animal-based transport to assist women, could be looked into.

University context and student theses

PROMETA has achieved a great deal on a limited budget by collaborating with other stakeholders. The use of students to undertake research has been an example of this. However the Project has realised that the methodology of participatory technology selection and evaluation is not the same as that required for collecting numerical data. The former encourages farmer-managed trials, the latter necessitates scientist-managed trials, if there is to be any likelihood of statistically significant results. Project staff have already addressed this issue, and have concluded that the Project targets will best be met by ensuring farmers are considered as partners in the research process. Therefore less emphasis will be placed on student thesis work involving quantitative data collection that significantly inconveniences the farmers without obvious benefits.

The involvement of students in Project investigations has potential benefits for all concerned. PROMETA has initiated discussions with the Faculty on ways in which participative research can be given appropriate academic recognition, even if it is largely qualitative. Care should be taken that students (and farmer collaborators) do not spend a long time collecting numerical data in situations where the sample size and inherent variation are such that chances of obtaining statistically significant results are remote.

Equipment

Transport technologies

Transport can play a major role in poverty elimination and improving livestock productivity (including the transport of fodder and manure). Animal-powered transport can be of particular social and economic benefit. Farmers with animal transport (pack animals or carts) generally have larger circles of contacts and trade than those without. The resulting enhanced market access allows them to increase their production and also their profit. With animal transport, greater use is made of manure and crop residues, which also increases overall farm production. Pack animals and/or animal-drawn carts can provide important local 'feeder' transport between farms, villages and markets. In recent years, the purchase of lorries by potato-growers has greatly reduced one of the traditional roles of pack animals in Bolivia. However, there remain many ways in which animals can complement motorised road transport systems.

Given the importance of technical, social and economic importance of transport in Andean valleys, PROMETA should continue to work on transport technologies. It may even be appropriate to give transport topics greater emphasis in the coming years.

Pack saddles

In many areas, pack animals are invaluable for local transport and they will continue to be important for transport of agricultural produce, forage, manure and a wide range of other goods and materials.

Farmers acknowledge that existing packing techniques are causing the animals health problems. The animals' backs are protected with blankets, but not with packsaddles. Thus the load puts pressure directly over the backbone and this results in sores. The sores cause the animals unnecessary suffering and reduce the effective load-carrying capacity. The problem may be solved at very little cost to the farmer/transporter, through the use of simple wooden packsaddles or even grass-filled pads that lie on either side of the spine. The project should study simple packsaddle technologies and initiate a participative evaluation of these.

Carts

In the valleys, there are many areas where the use of animal-drawn carts would be quite feasible. At present this technology is under-developed. PROMETA/CIFEMA has carried out some work in this area. It has collaborated with the FAO project and commissioned a student thesis relating to carts. In most areas, carts will need to have good braking systems, and PROMETA/CIFEMA has developed a prototype braking system that is being evaluated.

The development of efficient cart transport is often constrained by limited supplies of carts and/or the capital or credit to purchase them. However, animal-based transport is usually very profitable. As long as there are sufficient numbers of carts in an area, local artisans ensure the technology is sustainable.

The existing price of the carts is very high by world standards. PROMETA/CIFEMA, working with partner organisations, should endeavour to assure a supply of more affordable carts. The price should come down with economies of scale and cost-saving design features. CIFEMA should not necessarily concentrate on centralised manufacture of carts. In the medium term, it might be better to ensure a supply of cart components suitable for decentralised assembly in local workshop. The main requirement (and the main cost of the cart) is a good but affordable axle assembly with braking system. It is important that standard types of axles are used, so that the bearings can be easily replaced.

There is much evidence from other parts of the world, that the adoption of carts (and other transport technologies) is dependent on the establishment of a critical mass of users. In the promotional stage it may be better to introduce five carts into one single village rather than putting one cart into each of five different villages. Having several carts allows the development of artisanal repair and maintenance services, and people consider new uses of the carts as they become more familiar and accepted.

The Project (and/or its partner organisations) should concentrate its efforts in areas where the preconditions for success are most pronounced. Villages should be selected with conditions likely to favour cart transport (flat areas, with existing tracks and with significant economic transport requirements, such as a regular local market. In such identified villages, the aim should be for several (5-10) carts to be sold or placed with trusted partners (entrepreneurial farmers and transporters). If there is not an immediate economic demand, the first carts may have to be demonstration models on loan, with options for subsequent hire-purchase. The aim will be to have a few villages in which the cart technology has been proven to be technically appropriate for the valleys of Bolivia. Once a sustainable 'critical mass' of users has developed, the inherent profitability of transport should ensure continued expansion. Other partner organisations, attracted by success, will be able to continue the promotion in other areas.

Project partner organisations might consider the possibility of arranging income-earning schemes involving the animal-drawn carts. One example would be labour-intensive road construction and repair. Other ideas for transport of goods and materials by carts might also be considered. The aim would be to assist in the initial adoption of carts: once their use was well established, a wide range of local transport opportunities should assure their profitability.

The Project might also consider whether there could be a role for simple sledges, such as those used in Cuba. Sledges are less efficient than carts, and they can create water-ways that accelerate erosion. However they are very simple (a V-shaped log can be a sledge) and cheap. While carts can run away in hilly areas, sledges are much more stable (high resistance, high friction). While carts are generally better for the owners, the animals and the environment, sledges might be considered as a cheaper alternative in certain areas. This is not a recommendation to investigate or promote sledges, but is simply a reminder of an alternative transport option that might be considered during village discussions.

Animal nutrition and health

Nutrition is crucial to the success of animal traction. The shortage of available grazing and fodder is arguably the main limiting factor to animal power applications in the Andean valleys. In some areas, particularly at the higher altitudes, the total vegetative biomass seems low, with major seasonal fluctuations in production. It is therefore important that the Project continues to investigate nutritional issues, in collaboration with other organisations. Certain resources needed to increase feed supply, such as suitable land and timely labour, are in short supply, with competing demands from other farm enterprises. For this reason, greater attention might be given to the management of crop residues and the attraction of dual-purpose crops (human crops with fodder residue).

In continuing investigations into purpose-grown pastures, fodder bunds and specific fodder crops (such as alfalfa), the economic aspects should be considered carefully. Options for maximising income from such enterprises should be reviewed, and this might include increasing use of transport technologies (eg, carts) and/or the use of cows (as discussed below).

As noted above, the problem of pack sores is one animal health issue directly related to work animals. The Project should investigate the problem and possible solutions. Most animal health issues concerned with diseases and parasites are complex, wide-ranging and not specific to animal traction. The Project should therefore ensure its health-related activities address key limiting factors that directly affect the efficient use of work animals in the Andean valleys.

Work relating to stables should continue to be closely linked to transport issues (the carting or packing of manure and crop residues). The technologies must be evaluated with emphasis on economic issues, and this will probably result in lower-cost options being evaluated.

The Project might consider inviting Dr Anne Pearson of Edinburgh University to collaborate with the Project concerning animal-related issues. She has much relevant experience, particularly concerning the nutrition of working animals and the health and husbandry of donkeys.

Animal options

Traditionally, oxen have been the plowing animals of choice in the inter-Andean valleys of Bolivia. In some areas, work animals are selected from locally-bred male calves. However, in most of the communities in which PROMETA works, young male animals are bought in from the local livestock market. The oxen put on weight as they grow, and after a few years they are sold for a profit. The process of importing animals into the valleys from elsewhere may lead to the spread of diseases (de Roover, 1997).

There are two important factors that may make it difficult for farmers to justify maintaining oxen throughout the year in order that they are available for plowing. Firstly, oxen are increasingly expensive and the farmers find it difficult to afford the cost of the animals for plowing. Secondly, animal feed resources are extremely limited. In such circumstances in other areas, farmers may adopt one of two main strategies to justify maintaining animals for work. One is to use equids (horse, mules or donkeys) which can be used throughout the year for transport. The other is to use work cows, which can provide a reasonable amount of work, while providing additional outputs (milk, calves) to justify the year-round feeding. These strategies are employed in most parts of the world (including Bolivia) in areas where farming systems are intensifying in response to shortages of suitable land and feed resources and where the demand for draft work is light and/or very seasonal. The trend may not be so obvious where there are stratified livestock systems, in which surplus male animals from neighbouring areas are available and affordable. The provision of oxen in many valley communities is based on such a stratified system.

The Project should be aware of the alternatives to using oxen, and should discuss these with farmers. Where farmers express interest in evaluating alternative strategies, participative research may be indicated.

Equids

Equids (horses, mules and donkeys) are the main transport animals in all areas of Project intervention. They are mainly used as pack animals. They are important for carrying harvested produce, forage, fertiliser and manure. The increasing use of lorries has reduced the role of equids in transporting potatoes to market. However, equids remain widespread and are maintained throughout the year by many farmers.

There is already some use of single horses and single donkeys for tillage in Bolivia. Provided suitable equipment and harnessing techniques are available, more farmers may decide to employ equids for certain tillage operations, particularly low-draft operations. For light operations, horses are much quicker than oxen. Donkeys, being smaller, do not have the same strength and speed of a horse. The donkey power available for a certain operation can be increased if they are used in pairs, although this reduces the intrinsic simplicity of using a single donkey.

Cows

Cows are used for work in many situations where farming systems are intensifying and feed resources are scarce. This trend is clearly seen in many Asian countries, including Indonesia and Bangladesh. In North Africa and Europe most working cattle are cows. In Bolivia, the use of cows for plowing is common in the altiplano farming systems. Informal observations by the consultant and Project staff in the province of La Paz suggested that perhaps 50% of the animals used for plowing are cows.

Experience from other countries suggests that provided cows are well-fed, their production of milk and calves is not greatly reduced by work. Any reduction in productivity of working cows is compensated for by the benefits of work. The adoption process generally involves farmers replacing their oxen with cows. Thus provided the cows can do the work required of them (which is normally the case), any additional production of milk and calves is a bonus. If the feed resources previously used by oxen are allocated to working cows, with some additional supplementation, the overall outputs and benefits of the multipurpose work animals are increased.

In some of the valley sites visited, several preconditions exist that could favour the possible use of working cows, and this could be a means to improve livestock productivity. The topic appears particularly suited to participatory investigation in relatively intensive farming areas, where land and forage availability are already at a premium (eg, Capinota).

The Project should also stimulate, facilitate or commission a study of the present system(s) of using work cows in the altiplano. The conclusions of such a study, highlighting feeding strategies, production levels and the socio-economic costs and benefits, could be highly relevant to future developments in Cochabamba.

The Project (or one of the organisations with which it is working) should try to identify partner organisations working with communities in the altiplano where work cows are commonly used. The Project (or its partner organisations) should consider facilitating farmer-to-farmer exchanges as a means to discuss all the implications of using cows for work in Bolivian farming systems.

Buffaloes

In Chapare, there is a herd of water buffaloes owned by the University (UMSS). The buffaloes of Mediterranean (dairy) type, were imported from Brazil some years ago. Although they have proved adapted to the local environment, at present they have no obvious role. They are being maintained under ranch conditions, without being milked, and the herd is becoming in-bred. The University Authorities would like to see this resource more effectively employed, and one possibility is employing them as multipurpose work animals. Recently, Project personnel have been asked specifically to consider possible options, and for this reason some of the issues involved are outlined below.

In other countries, water buffaloes can be employed for work, and it can be reasonably assumed that the University's water buffaloes could be trained for effective work. Initial training would pose some problems, because the buffaloes have not been used to close human contact. (In a similar way, ranches cattle are more difficult to train than animals brought up in a homestead.) However there seems little point in starting to train the buffaloes unless a clear role for them can be identified. To justify the promotion of water buffaloes, there should be a clear potential niche in which they have a comparative advantage over alternative animals (work oxen and equids).

Water buffaloes are important for work in some Asian countries. They are particularly well-adapted to the cultivation of rice swamps, with large feet and the ability to thrive on diets based mainly on rice straw. Although mainly employed for rice cultivation, buffaloes can be used singly or in pairs for upland plowing and for pulling carts or sledges. They are less adapted to such operations than cattle, being less efficient at thermoregulation. Buffaloes have many fewer sweat glands than cattle (only 10-20% the number that cattle have), and so during hot weather or during work they find it difficult to lose heat unless they wallow in water. Generally, cattle and buffaloes have similar pulling ability relative to their weight. Cattle tend to walk faster than buffaloes of similar size, although buffaloes are much better at walking through mud. The reproductive efficiency of cattle is generally higher than that of buffaloes (although the Escuela Agrícola Panamericana in Zamorano, Honduras has achieved some excellent birth-rates among its dairy buffaloes).

With the exception of humid south-east Asia (where non-dairy types of 'swamp' buffaloes or 'carabao' are commonly employed), cattle tend to be more widely used for work than buffaloes. In north Africa and southern Europe, where there have long been significant populations of dairy buffaloes, the buffaloes were seldom employed for work on a large scale (oxen, cows and equids remained the work animals of choice for most people).

In Latin America there are significant populations of water buffalo populations in Brazil, and small populations in several countries including Argentina, Bolivia, Colombia, Cuba, Honduras, Peru and Venezuela. Most are 'River' (dairy) breeds maintained under ranch conditions by public sector organisations or on large farms/estates. In most countries they have been demonstrated to be capable of work (carting, logging and some soil tillage). One recent study of their work potential was carried out in Colombia (Galindo, 1998) and experiences in Honduras and Brazil were recently reported in El Yuntero (FOMENTA, 1998). However, the consultant is not aware of significant numbers of buffaloes being used as multipurpose work animals anywhere in Latin America. In Bolivia, one large farm in Santa Cruz uses buffaloes to produce milk for mozzarella cheese. The animals are considered valuable, with prices of over US\$1000 per animal being quoted.

The population of buffaloes in Bolivia is small, and therefore in the short- and medium-terms, oxen (or cows) are likely to remain more available and more affordable than buffaloes. Where the buffaloes live in the Chapare area, there is very little use of animal traction. Unless buffaloes can be shown to be

technically superior to local oxen, or unless a second economic function such as buffalo milk production can be introduced, cattle are likely to be preferred in the long run.

Trying to identify a 'problem' for which the buffaloes can be the 'solution' should not distract the Project from its other important on-going work with oxen, cows and equids. However, similar questions about the potential use of buffaloes are being asked in several countries in Latin America. It would be interesting if someone from Bolivia or elsewhere could collate information concerning the various uses of water buffaloes in Latin America, and their implications for smallholder and estate farming systems. This might be done in association with RELATA, by including the potential for water buffaloes as one of the sub-themes of the coming RELATA international workshop. A careful review of this information would help the University (UMSS) identify possible niches for buffaloes in Bolivian farming systems. Only once other Latin American experience has been reviewed and a realistic niche has been identified, would it be worth spending time comparing buffaloes and cattle, in terms of their work capacity, survival, production, reproduction, social acceptability and economic viability in Bolivian farming systems.

Networking and RELATA

Networking

Networks link people and encourage them to collaborate and learn from each other. Animal traction networks, both national and international, are particularly important for animal traction programmes because animal power has been a neglected topic and those concerned with it have tended to work in relative isolation with little professional support. For more than ten years, national and international animal traction networks have proved valuable in Africa. The African networks have increased information exchange, cooperation and technical progress in the field of animal traction. The participatory farmer-centred workshop methodology developed by the networks has been instrumental in improving animal traction understanding and professional competence.

In the past few years, comparable network initiatives have been taking place in Latin America. Although social, economic and technical conditions in Latin America are different from those in Africa, there are some important similarities regarding animal traction. The technology is important for smallholder farmers, but many institutions and authorities have neglected it. Professionals have little access to animal traction experiences in other countries. They sometimes feel institutionally isolated and unsupported within their own countries. The valuable networking methodology adopted by organisations such as PROMETA and FOMENTA (Programa Regional de Fomento de la Tracción Animal) is exceptional, and should be encouraged and developed further.

National network and national workshop

The Project should be taking a long-term view concerning the impact of its work. Although CIFEMA is likely to have a long future, PROMETA is a temporary structure. The promotion of the image and reputation of PROMETA will have little long-term value. On the other hand, it is necessary to spend time and energy ensuring that the ideas and technologies developed by PROMETA are not ephemeral. One way to achieve this would be through the promotion of a national animal traction network, with CIFEMA providing initial coordination. If PROMETA facilitated the formation of such a network, this could be used as a channel for Project publicity outputs. The network should outlive even a two-phase Project, and CIFEMA and other network members should be able to take over key Project activities, with support from a variety of funding agencies. During the visit, partner organisations contacted supported the idea of a national network.

The Project already has plans for a workshop involving partner organisations in February. It is proposed that this workshop be used to launch the national network. A wide variety of organisations and individuals concerned with animal traction in Bolivia should be invited. Efforts should be made to ensure that there is participation from other areas of Bolivia. This will not only strengthen the network, it will also allow PROMETA to gain from information exchange concerning other animal traction experiences in Bolivia (eg, use of work cows in La Paz, use of donkeys for plowing in Potosi, cart technologies in Santa Cruz).

Collaboration with RELATA

The international Latin American animal traction network RELATA (Red Latinoamericana de Tracción Animal) was launched in 1995. In 1997, a full-time RELATA coordinator was appointed, working in the regional Fomenta programme, based in Nicaragua. Fomenta provides secretarial and infrastructural support and has allowed its attractive magazine, *El Yuntero*, to be used as a network newsletter. FOMENTA has a Central American mandate, and this has slightly restricted the impact of RELATA in South America. It would be to the benefit of RELATA and South American countries (including Bolivia) if national and international networking activities based in South America could be initiated.

PROMETA is in a good position to gain more from, and contribute more to, RELATA. It is suggested that PROMETA/CIFEMA host an international workshop, to be organised in conjunction with RELATA. This would allow the Project, and associated organisations, to learn new ideas of benefit to Bolivian farmers, that could be followed up by members of the national network and/or a second PROMETA phase. At the same time, CIFEMA and PROMETA would gain international exposure for their work, and this could ultimately have a positive impact on farmers in other countries.

In the course of this mission, representatives of COSUDE and DFID were approached about possible co-funding for such a workshop. They indicated that detailed proposals would receive very sympathetic consideration, and PROMETA/CIFEMA can be optimistic about obtaining the necessary support. It would be helpful if all interested parties, including RELATA, could be represented at the national workshop (in February 1999) in order to start detailed planning. The international workshop could be held in November 1999.

El Yuntero, is a very attractive quarterly publication produced by FOMENTA in Nicaragua, which is used by RELATA to disseminate information in Latin America. A recent issue contained an article on CIFEMA research on the Bolivian 'Arado Ecológico'. This four-page article illustrated the benefits of information exchange and publicity, but its optimistic presentation also highlighted the need for clear and objective reporting of participatory investigations. 'El Yuntero' is a valuable resource and PROMETA/CIFEMA, together with other Bolivian organisations, should make greater use of it by increasing its readership in Bolivia and by contributing more articles.

Training and publications

There is a serious shortage of publications concerning animal traction in Bolivia. This means that the topic is inadequately covered in all education and training systems in Bolivia. This includes schools, universities, training institutes and NGO training schemes. PROMETA and its partner organisations should make efforts to improve the situation. In recent years, most technical material relating to animal traction has been published in English and French. Some of these could be translated into Spanish. However, technical publications focussed on the specific situations and problems found in Bolivia and Latin America would be preferable. Since there is a similar shortage of suitable publications in other Latin American countries, there should be scope for collaboration. Co-publication with organisations such as RELATA/FOMENTA, as well as institutions in Mexico and Cuba may be feasible. The existing problems and potential initiatives should be discussed during the proposed national and international workshops.

During the mission, the educational and motivational value of a range of clear animal traction pictures was demonstrated. PROMETA and its partner organisations could benefit from one or more sets of such pictures.

Relevance of PROMETA to DFID aspirations

Contributions towards Project Goal

The PROMETA research Project has only been operating a short time, and it is unrealistic to expect it to be having a significant impact on livestock productivity and poverty elimination. However it is already having some impact on certain communities, on collaborating organisations and on research processes. Due to the collaborative nature of the Project, credit for this impact is shared with several organisations. Extrapolating possible future benefits involves major assumptions that cannot really be justified at this stage of the Project life. Nevertheless, some potential benefits can be identified, and time will tell whether these are indeed forthcoming.

Livestock productivity may be enhanced in the following ways. Sown pastures may eventually improve animal feed resources and the soil fertility in fallow land, while reducing erosion. Fodder bunds may improve livestock feed resources (although this is not yet clearly demonstrated). Animal-drawn carts (if adopted) could lead to improved use of organic manure, greater stocking of crop residues and/or greater use of forage crops. If equids are used for soil cultivation, this will enhance their overall production (work), relative to their annual feed costs. If packsaddles are adopted, there will be less animal suffering and less production lost due to lesions. If Project-developed soil tillage implements have lower draft for comparable work quality, animal energy will be saved and productivity enhanced. If Project-developed soil and water management techniques prove effective, there will be less erosion, less pasture/fallow land lost and relatively greater production of crops and crop-residues. Such linkages cannot yet be demonstrated, but they are not unreasonable Project expectations.

Contributions towards poverty elimination

The consultant was asked to develop a flow diagram to illustrate some of the linkages between envisaged Project outputs and the alleviation and elimination of poverty. Inevitably, such a diagram would represent highly complex processes in a simplistic way.

To give some idea of the complexity of the context of Project actions, Chart 1 shows some of the factors that can affect the adoption of animal power technologies, such as those being identified and evaluated by the Project. Chart 1 includes almost a hundred criteria, grouped under the interacting themes of animal issues, technologies, agro-climatic environment and socio-economic conditions. The majority of these criteria could have a direct influence on whether or not the project technologies are adopted, and they include some very complex elements, such as animal nutrition, risk, technology design, land pressure and farmer aspirations.

Poverty alleviation and elimination is also highly complex and Chart 2 shows some of the factors that can affect the processes. Many of the factors that influence poverty have little or nothing to do with the subjects being addressed by the project: for example, life expectancy, land tenure, electricity and interest rates. Nevertheless, twelve areas are highlighted in which Project outputs could make a difference. These include enhanced income, more sustainable resources, reduced drudgery, lower risk, enhanced skills and improved transport and market access.

While acknowledging the danger of extrapolation at such an early stage of the Project, certain potential affects of Project outputs on poverty alleviation/elimination can be postulated. Cart adoption and/or improved packing technologies should reduce drudgery and enhance agricultural production, marketing and trade. Women should be among the major beneficiaries since they are often responsible for growing fodder and carrying feed to animals. Agricultural incomes should be increased through enhanced livestock productivity, made possible through improved nutrition, better health care and/or use of alternative animal types. Improved soil and water conservation systems should increase agricultural productivity and/or reduce land/productivity losses due to erosion. This should enhance the sustainability of resources, reduce risk and increase incomes. Improved income from greater crop production could also come from more effective or timely tillage, attributable to implement types or diversified animal-powered operations. Increases in crop and livestock production should be synergistic, due to greater production and use of manure and crop residues. These possible linkages are shown in Chart 3.

It must be stressed that while the flow chart shows some possible paths with simple cause and effect relationships, the reality is much more complicated. The paths shown could be significantly influenced by many factors beyond the control of the Project, including weather, insecurity, changing market conditions or some of the other determinants noted in Charts 1 and 2.

Most envisaged Project outputs should be beneficial and their adoption should eventually benefit most or all members of the rural communities. However, in the first instance, adoption of technologies leading to higher or more efficient production will lead to greater economic differentiation, as the adopters benefit more than the non adopters. This will make the poorest members of the communities feel relatively poorer, even if their standard of living has not changed. This appears an inevitable consequence of any gradual adoption process.

Constraints to Project impact

Provided the Project outputs prove to be technically, socially and economically appropriate, adoption should follow, and the Project will have an impact. The constraints are likely to be technology supply (seeds, implements, carts), extension advice and credit provision (particularly important for cart adoption). CIFEMA, and cooperating workshops, have the facilities and experience for cart and implement production. A range of Projects and NGOs is working in specific areas or on particular themes. DFID could assist these directly or indirectly in various ways. There is a proposal for a DFID-supported Agricultural Services Project, and this would be able to work with other organisations to target resources to assist the adoption of valuable technologies. Another highly cost-effective means might be by supporting the proposed animal traction network with strategic training and information dissemination. If a team of people similar to the present Project personnel were to support the network, human and financial resources from many different organisations could be mobilised to help alleviate the constraints.

Relevance of PROMETA to other countries

Although many of the actions and outputs of PROMETA are location specific, they may well have relevance for other countries. Firstly, the participatory, collaborative and inclusive methodology of the Project should be relevant to initiatives in most countries. The lightweight tillage implements and harness could have relevance to many locations including Mexico and countries in the semi-arid regions of Africa. The cart braking system, if proved effective and affordable, could have relevance to many countries, including Kenya. Recommendations for tillage implements and soil-water management in hillsides, could prove of value to hillside cultivation systems in many countries, including Nepal, Kenya, Ethiopia, Eritrea and India. If simple and effective improvements can be made in packing technologies, this could have implications for many countries where donkeys are used for packing, including India, Nepal, Kenya, Brazil and Mexico.

Conclusions

In conclusion, PROMETA has achieved a great deal in a short time, with very limited resources. It has been undertaking most of the envisaged Project activities, and is well on its way to achieving the envisaged output recommendations relating to animal management, animal-drawn equipment and soil and water conservation systems. It is recommended that PROMETA continue its present programme and methodology with some minor modifications.

The Project provides a good example of what can be achieved by dedicated staff, inter-institutional cooperation and participatory processes. Although it is too early for Project actions to have had a significant impact on the target communities, there are reasonable grounds for anticipating a long-term and sustainable impact on crop and livestock productivity and rural livelihoods.

Although there should be clear achievements within the life of the Project, the work and processes initiated by the Project will need further time to ensure sustained development is attained. In order to maximise the long-term benefits of the current work, the Project, and its supporting organisations should start preparing for a second three-year phase of the Project.

Suggested action points

*Possible follow-up actions for consideration by Project leaders
(the order of their presentation is not significant)*

General

- Continue with similar methodology and enthusiasm
- Start considering actions needed to ensure a second phase of Project
- Work towards formation of a national animal traction network to increase information exchange and collaboration and help assure the long-term diffusion of Project ideas and outputs
- Offer to host RELATA's 1999 Latin American workshop and liaise with other interested organisations to achieve a successful outcome
- For national workshop (February 1999) try to ensure participation of RELATA and additional Bolivian organisation(s) including ones working with cow-using farmers, donkey-using farmers and cart-using farmers

Animal issues

- Continue the existing collaborative programmes relating to nutrition, pastures, use of horses and donkeys, stables, etc
- Place greater emphasis on dual or multipurpose crops with fodder residues
- Obtain information on the role of working cows in the altiplano and consider research on cow use in the valleys
- Consider inviting Dr Anne Pearson for collaborative work
- Consider options for a review of the Latin American experiences with water buffaloes (perhaps through RELATA and/or inclusion of this topic at proposed RELATA/CIFEMA workshop)
- Ensure Project work on transport is closely linked to work on nutrition (transport manure/fodder)
- Ensure Project work relating to stables and manure considers economic implications of designs
- Consider a study of gender aspects of animal traction, including access to animals by female-headed households and issues relating to the transport of forage

Equipment

- Continue the existing collaborative programmes relating to implements and harnesses
- Place greater emphasis on transport-related technologies and the creation of a 'critical mass' of users
- Consider ways of lowering the costs of animal-drawn carts with brakes
- Consider ways in which Project collaborators could facilitate the adoption of carts (eg, credit and income-generating schemes)
- Investigate and evaluate low-cost pack saddles
- Ensure the new high-lift equipment will work effectively with sub-optimal angles of pull

Soil and water conservation

- Continue and further develop (as envisaged) the existing collaborative programmes relating to bunds, terraces and use of tillage tine (Cincel) and reversible plows

Approaches and publications

- Consider ways to increase socio-economic and gender-related perspectives in Project work
- Consider ways of encouraging more self-critical and analytical approaches to Project work
- Consider additional training in participative approaches for Project staff and collaborators, which might include sessions during the proposed national and international workshops
- Continue to discuss with University ways in which participative research can receive appropriate academic recognition
- Encourage Bolivian Project staff to prepare publications on Project methodology and experiences for international audiences (eg, proposed RELATA workshop and/or 1999 ATNESA workshop).
- Consider ways to overcome the shortage of animal traction publications in Spanish language (possible collaboration with RELATA; possible discussion of issues at the coming national and international workshops)
- Consider developing/obtaining sets of photographs suitable for stimulating discussion of animal traction issues relevant to the Project's programme

Chart 1: Some factors that affect animal power adoption and use by farmers

Chart 2: Some factors that affect poverty alleviation/elimination

Chart 3: Flow diagram linking Project outputs and poverty elimination

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- Starkey P, 1990. *Policultores de tração animal: perfeitos porém rejeitados*. Assessoria e Serviços a Projetos em Agricultura Alternativa, Rio de Janeiro, Brasil and German Appropriate Technology Exchange, GTZ, Eschborn, Germany. 152p.

Project Logical Framework

Terms of Reference

- 1 Paul Starkey will visit PROMETA in Cochabamba Bolivia for two weeks from 12 October 1998 to undertake a mid-term review of the Project. He will review the achievements to date and suggest appropriate future directions for the Project.
- 2 Review existing Project documentation (Working Documents, conference papers, refereed papers, diffusion literature) and make suggestions for future dissemination.
- 3 Visit the Project collaborating communities accompanied by Quechua speaking Project staff. Visit other regions of the Bolivian inter Andean valleys (and elsewhere as mutually agreed).
- 4 Meet with all Project stakeholders (researchers, field technicians, CIPCA, ASAR, CIF, World Vision, FAO, CIMMYT, PROINPA, Veterinary Faculty) to evaluate the interaction.
- 5 Recommend measures to achieve greater interaction with RELATA.
- 6 Give a seminar on AThe importance of participatory research in animal traction in Bolivia≡.
- 7 Participate in technical sessions with PROMETA staff to discuss initial conclusions and leave an Aide Memoir.
- 8 Identify linkages between the foreseen research outputs of PROMETA and their relevance / uptake / impact in other countries such as India, Nepal, Kenya, Brazil, Mexico.
- 9 Compose a flow diagram illustrating the linkages (research products and stakeholders) between PROMETA and alleviation / elimination of poverty in one or two target areas in Bolivia. What are the constraints to achieving impact? Can they be addressed by DFID actions?
- 10 Review the contributions of PROMETA=s outputs to achieving the Project Goal.
- 11 Prepare and deliver a report of the findings of the review within one month of mission completion.

Itinerario / Itinerary

Domingo 11 de Octubre de 1998

Viaje a Bolivia

Lunes 12 de Octubre de 1998

Llegada a Bolivia y viaje a Cochabamba
Visitas y discusiones PROMETA y CIFEMA
Discusiones Proyecto Laderas

Martes 13 de Octubre de 1998

Visitas y discusiones PROMETA/CIFEMA
Visitas y discusiones UMSS
Visitas y discusiones IBTA

Miércoles 14 de Octubre de 1998

Visitas y discusiones Comunidad Capinota
Visita y discusiones Visión Mundial Capinota
Visita y discusiones PRODEM, Capinota

Jueves 15 de Octubre de 1998

Visitas y discusiones PROMETA/CIFEMA

Viernes 16 de Octubre de 1998

Visitas y discusiones Comunidad Piusilla

Sábado 17 de Octubre de 1998

Revisión de documentación del Proyecto

Domingo 18 de Octubre de 1998

Preparación de conferencia

Lunes 19 de Octubre de 1998

Visitas y discusiones Comunidad Tiraque

Martes 20 de Octubre de 1998

Conferencia sobre la tracción animal, UMSS

Miércoles 21 de Octubre de 1998

Visita y discusiones FAO Fertisuelos

Jueves 22 de Octubre de 1998

Discusiones PROINPA
Discusiones Asesor de DFID
Visita y discusiones ASAR

Viernes 23 de Octubre de 1998

Visitas y discusiones Tiraque
Visita y discusiones con CIPCA
Visita y discusiones con el Rector de UMSS

Sábado 24 de Octubre de 1998

Reunión final de la evaluación con PROMETA

Domingo 25 de Octubre de 1998

Visita y **discusiones IBTA**, La Jota, Chapare
Visita y discusiones Valle de Sajta, Chapare

Lunes 26 de Octubre de 1998

Visita y discusiones PDAR, Villa Tunari
Visitas y discusiones Comunidad Corani
Pampa

Martes 27 de Octubre de 1998

Visitas y discusiones comunidades en Potosí:
Torno Kasa, Niño Kollo, Sakani Alto y Chiro
K'asa

Miércoles 28 de Octubre de 1998

Conferencia sobre la tracción animal
Chiro K'asa
Visitas comunidades Dymaya y Chayanta,
Potosí

Jueves 29 de Octubre de 1998

Visita y discusiones COSUDE, La Paz
Visitas y discusiones Comunidad Chiro Ka
Compi y Teodocio, La Paz

Viernes 30 de Octubre de 1998

Fin de misión

Personas entrevistadas / Persons contacted

CIFEMA

Ing. Jaime Mendoza, Director
Ing. Leonardo Zambrana, Coordinador
PROMETA

Ing. Mario Huanca, Coordinador de cursos
Ing. Rene Flores, Técnico de Campo
Ing. Jorge Velasco, Técnico de Campo
Ing. Vladimir Plata, Técnico de Campo
Ing Daniel Velasco, Responsable Extensión
Agrícola

Tesistas

Julio Cesar Antezana (Diversificación)
Juan Carlos Céspedes (Sistemas de labranza)
Melby Rodríguez (Praderas)
Victor Copa (Nutrición)
Jony Cruz (Implemento múltiple para papa)
Patricia Torrejón (Carreta)
Alcides Calisaya (Sembradora, CIMMYT)
Silvio Nina (Cereales y leguminosas)
Paulino Villena (arado de cincel, PROINPA)
Marta Calle (Veterinario)
Victor Leiva (Veterinario)

UMSS

Dr Alberto Rodríguez, Rector

Facultad de Agronomía

Ing Jaime la Torre, Decano
Ing Carlos Rojas, Director Académico
Ing Rosario Torrico, Directora de Investigación

IBTA Tarata

Mario Crespo, Director Programa Trigo

Visión Mundial Capinota

Evangelina Moya, Directora
Hugo Navarro, Agronomía
Martín Aguilar, Promotor

Agricultores de Sarcobamba y Sarcocucho, Capinota

Gabino Coca
Gualberto Pérez
Santiago Chávez
Mario Medrano
Agustín Jora
Juan Carlos Zurita
Sebastiana Achacata Pascual

PRODEM, Capinota

Walter Rodríguez, Asesor de Créditos

PROINPA

Noal Ortuño

FAO Fertisuelos

Guido d'Onofrio, Director Proyecto
Cesar Perez Rueda, Experto en extensión

CIPCA

Lorenzo Soliz Tito, Director Regional
Bernadino Soliz V

DFID

Geoffrey Gilman

ASAR

Juan Demeure V

Piusilla, San Isidro

En total se entrevistaron un grupo de 13
hombres y 8 mujeres entre ellos

CIAL

Juan Ruiz López, Presidente
Gregorio Begamonte

Asociación de Damas

Margarita López, Presidenta

Otros

Leandro Ruiz (caballos de carga)
Hilarión Begamonte
Máximo Tapiz
Victor Pérez (Director de la Escuela)

Tiraque

Rafael Vásquez, CIFEMA Taller

Kolque Joya

Patricio Galindo (Colaborador)
Ricardo Bustamante (Dirigente del Sindicato)
Reunión con 12 agricultores.

Boquerón Kasa

Juan Orellana (Colaborador)
Felipe Vásquez (para-veterinaria)
Antonio Villarroel (Dirigente)
Julián Céspedes
Andrés Céspedes

Palca

Roberto Garcia
Don Acedes Mayta
Francisco Mayta
Andrea Cuellar
Garbeala Corneho Jasica

IBTA, La Jota, Chapare

Fernando Borges

Valle de Sajta, Chapare

Diter (Encargado)

PDAR (Programa de Desarrollo Alternativo Regional), Villa Tunari

Ingrid Flores (Administradora)

Corani Pampa

Hugo Fernández

Urs Schroff (Centro Ecológico Las Orquídeas)

Ennio Grisa (Centro Ecológico Las Orquídeas)

Potosí, Bilbao

Epitanio Oziada

Anzaldo Kaballusta

Torno Kasa

Nicolas Mamani Flores

Niño Kollo

Rene Temprano Clabara

Sakani Alto

Carlos Medrayo Martínez, Vecinos Mundiales

Alejandro Mamani Chambi

Chiro K'asa

Liborio Oporto, Director

Ana Aranas Nieto, Responsable Mujeres

Filamon Colque, Alade

La Paz

Andres, Chiro Ka

Victor, Compi

N Mamani, Chilon, Teodocio

COSUDEChristian Pellaud, Jefe de Finanzas y
Administración

Dr Willi GRAF, Coordinador Adjunto

Siglas / Abbreviations

ASAR	Asociación de Servicios Artesanales y Rurales
CIAL	Comité de Investigación Agrícola Local
CIF	Centro de Investigaciones Forrajearas
CIFEMA	Centro de Investigación, Formación y Extensión en Mecanización Agrícola
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIPCA	Centro de Investigación y Promoción del Campesinado
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement, France
DFID	Department for International Development, R-U
FCAPFV	Facultad de Ciencias Agrícolas, Pecuarias, Forestales y Veterinaria
FOMENTA	Programa Regional de Fomento de la Tracción Animal, Nicaragua
IBTA	Instituto Boliviano de Tecnología Agropecuaria
PDAR	Programa de Desarrollo Alternativo Regional
PRODEM	Fundación para la Promoción y Desarrollo de la Microempresa
PROINPA	Programa de Investigación de la Papa
PROMETA	Proyecto Mejoramiento Tracción Animal
RELATA	Red Latinoamericana de Tracción Animal
UMSS	Universidad Mayor de San Simón

**TRACCION ANIMAL:
UNA VISTA MUNDIAL CON ENFOQUE EN LOS
ASPECTOS RELEVANTES A BOLIVIA**

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Temas claves

- ! Diversidad del empleo de la potencia de los animales
- ! Contracción, persistencia, expansión
- ! Incremento de complementaria
- ! Importancia de tracción animal para el transporte
- ! Incremento del empleo de vacas para trabajo
- ! Selección y alimentación de animales de trabajo
- ! Aspectos de género y acceso a animales de trabajo
- ! Animales de trabajo en la agricultura de laderas y conservación
- ! La necesidad para investigación participativa
- ! La necesidad para prestigio mejorado y consideraciones de política
- ! La importancia de redes de tracción animal

La Diversidad de Animales de Trabajo

- Muchas especies están empleadas a nivel mundial (bovinos, caballos, burros, mulas, yacs, llamas, cabras, perros, elefantes, etc).
- Bueyes son extremadamente importantes en términos de números, pero están en descenso debido a su velocidad lenta, su costo elevado y el riesgo de robo
- Vacas suelen reemplazarles a bueyes como animales de trabajo parcial donde terreno o alimentación se escaseen
- El empleo de burros esta incrementándose como una opción barata, de bajo riesgo y resistencia a sequía. Principalmente para transporte pero también labranza
- Caballos normalmente percibidos como animales de transporte especializados que pueden aprovecharse para trabajo de finca, principalmente en áreas templadas y altas debido a problemas de salud
- Mulasson son generalmente costosas, pero son frecuentemente preferidas para trabajo a tiempo completo en países con una población alta de caballos

Contracción, persistencia, expansión

Contracción

- ! El empleo de animales de tracción se ha reducido marcadamente en países altamente industrializados y urbanizados (p.ej. Norte América, Europa del Norte, Japón)
- ! en estos países el terreno del pequeño productor ha sido adquirido por terratenientes
- ! La mayoría de la gente tiene acceso a transporte motorizado a un costo moderado
- ! Como estos países dominan los medios de comunicación mundiales (especialmente TV y películas) la contracción de la tracción animal es una tendencia bien conocida

Persistencia

- ! La tracción animal es muy persistente en áreas de uso tradicional en África, Asia y América Latina
- ! Permanece persistente en la mayoría de las áreas donde hay muchos mini-fundistas con acceso a animales y forraje y donde la mayoría de la gente no tienen acceso a transporte motorizado económico
- ! Tecnologías de fabricación local son muy persistentes (p.ej el arado de palo)
- ! Hasta en los países desarrollados el uso de animales para la agricultura y transporte puede ser muy rentable (p.ej los Amish y Menonitas)

Expansión

- ! La tracción animal esta en expansión actualmente en África de sub-Sahara
- ! También se esta difundiendo en ciertas áreas de Asia y América Latina, notablemente en las zonas de interfase del bosque y en laderas
- ! Dicha expansión recibe poca atención a nivel mundial

Complementariedad

- ! Motorización y tracción animal podrían ser complementarias. La asociación complementaria de animales y motores esta en aumento, notablemente para:
 - X labranza primaria y secundaria
 - X Transporte de larga distancia y transporte local
- ! Potencia animal suele tener una ventaja comparativa para:
 - X El movimiento de productos de la parcela al pueblo y el pueblo al mercado
 - X Transporte en-finca sobre distancias cortas, especialmente para forraje y abono
 - X Transporte entre pueblos en cerros y terreno difícil
 - X Recolección de agua doméstica
 - X Transporte urbano de bajo costo
- ! Cuando potencia motriz esta disponible para trabajo pesado, los bueyes suelen ser reemplazados por vacas o burros que son capaces de realizar trabajo liviano

Transporte

- ! El acceso a transporte económico es un aspecto muy importante del desarrollo rural y la eliminación de pobreza. Afecta la producción agrícola, mercadeo, rentabilidad y la calidad de vida de hombres, mujeres y niños.
- ! tracción animal es muy importante para transporte de pequeña escala que permite:
 - X reducción de trabajo pesado, particularmente para mujeres
 - X Círculos más amplios de producción y comercio
 - X Estimulación de mercadeo y economías locales
 - X Transporte de forraje y abono mejora la integración de cultivos y ganadería, reciclaje de nutrientes y nutrición animal
- ! En Asia, América Latina y el Norte de África, el transporte con tracción animal es altamente persistente y complementario a la potencia motriz
 - X Transporte y mercadeo es frecuentemente más rentable que producción
 - X Beneficios económicos aseguran la continuación de tracción animal si no se socava por la competencia de subsidios, legislación o consideraciones negativas de imagen / prestigio
 - X En algunas áreas, sobretodo en África de sub-Sahara, el empleo de animales para el transporte esta en acenso.
 - X En muchos países de América Latina existe el potencial para incrementar el empleo de animales de carga y/o carretas tiradas por animales
 - X En muchos países existe la necesidad para una buena fuente de carretas económicas de tracción animal con sistemas de frenos efectivos.

El empleo de vacas para trabajo

- ! En la mayoría del mundo se encuentra un uso cada vez mas grande de vacas para trabajo liviano (deshierbe y transporte con carretas)
- ! El empleo de vacas de multi-proposito podría ser mas rentable que el uso de bueyes dado que las vacas producen leche y terneros en adición a trabajo, estiércol y carne
- ! Si la s vacas se alimentan bien, pueden producir terneros con regularidad y cantidades normales de leche
- ! Las condiciones que propician el cambio de bueyes a vacas incluyen:
 - X El alto costo de bueyes y/o el riesgo de robo
 - X Escasez de pastoreo o producción de forraje
 - X Sistemas de cero-pastoreo (estas condiciones e encuentran el agricultura de riego y sistemas intensivos de ladera
- ! Las pre-condiciones que desaniman el empleo de vacas incluyen:
 - X El requerimiento para trabajo regular y pesado
 - X Una fuente barata de bueyes (p.ej. sistemas estratificados de agricultura)
 - X Amplio pastoreo
 - X Falta de mercados para leche o carne
 - X Disponibilidad de equinos de transporte para realizar el trabajo
- ! Tradiciones culturales y preocupación con el uso de vacas podrían cambiarse rápidamente donde el empleo de vacas es rentable

Razas de animales y nutrición

- ! Los animales mas grandes de trabajo son fáciles de criar pero generalmente las funciones múltiples y limitaciones ambientales lo restringen
- ! Equinos de transporte (burros, caballos y mulas) se emplean cada vez mas para trabajos de finca y transporte con carreta
- ! Los burros son baratos y resistentes a la sequía, mientras que caballos y mulas tienen mayor potencia y mas prestigio
- ! Razas exóticas y especies podrían ofrecer algunas ventajas, pero pequeños productores generalmente necesitan animales que sean resistentes y baratos para comprar y mantener
- ! La nutrición es frecuentemente una limitación mayor
- ! Suele existir una limitación económica y no una falta de conocimiento dado que animales que generan ingresos (p.ej. animales de transporte o vacas lecheras) reciben mejor nutrición que animales de labranza

Temas de Género

- ! Históricamente los animales de trabajo y su control han sido el dominio de los hombres
- ! Las mujeres solían jugar papeles importantes en la producción agrícola y son los principales transportadoras de bienes y requerimientos domésticos. Hay mucho potencial para reducir las labores onerosas de la mujeres y aumentar su productividad por medio del uso de animales
- ! Acceso a la capacitación relevante y a crédito es mas difícil para mujeres
- ! El empleo de animales de trabajo por mujeres esta en aumento, p.ej cuando los hombres salen a trabajar en los pueblos (o fallecen con SIDA) las mujeres emplean tracción animal para operaciones de transporte y labores culturales
- ! Conforme los hombres adopten nuevas tecnologías (p.ej. motos, tractores), las mujeres tal vez tengan mayor acceso a las tecnologías mas antiguas de tracción animal
- ! Burros ofrecen beneficios particulares a las mujeres (bajo costo, facilidad de adiestramiento, trabajo y manejo y falta de limitaciones culturales)

Agricultura de Laderas

- ! Presión sobre la tierra resulta en mayor difusión de agricultura de laderas con barbechos mas cortos y mayor deforestación. El riesgo de erosión es muy seria
- ! La tracción animal puede ser empleada en laderas, siempre cuando existen medidas apropiadas de conservación e implementos adecuados (p.ej. arados reversibles)
- ! Animales de trabajo puede ser empleados en la formación de terrazas
- ! El forraje para los animales de trabajo (bueyes, vacas, caballos, burros) puede ser sembrado en barreras vivas

Investigación Participativa

- ! Históricamente el desarrollo de la tracción animal fue enteramente por iniciativa del sector privado (notablemente la cooperación entre agricultor y herrero)
- ! La mayoría de las tecnologías de tracción animal se han difundido de agricultor a agricultor sin extensión formal
- ! Investigación y desarrollo impuestos desde arriba, incluyendo investigación en espacio con poco contacto con agricultores, muchas veces ha resultado en tecnologías que han sido rechazadas por agricultores (p.e. porta-implementos con ruedas)
- ! Enfoques centrados en agricultores y participativos e investigación y desarrollo en finca, son necesarios para el éxito
- ! El enfoque participativo requiere un conocimiento del entorno social, económico y ambiental, incluyendo el tema de género
- ! Hay la necesidad de aprender de fuentes indígenas técnicas y tratar a los agricultores como socios en el proceso de investigación
- ! La promoción de nuevas tecnologías podría acelerarse al quitar las limitaciones de suministro, mejorando el acceso al crédito y un enfoque cuidadoso que ayuda a la creación de una masa critica de usuarios
- ! Existe la necesidad para capacitación en métodos participativos

Prestigio y temas de política

- ! En muchas áreas la tracción animal es una tecnología apropiada económica y ecológicamente, que se quedará muy relevante a los pequeños productores para el futuro previsible
- ! La potencia animal tiene una imagen anticuada sobre todo con lo jóvenes. Eso ha sido influenciado por los medios dominados por el oeste
- ! Algunas autoridades prohíben o desaniman la potencia animal (p.e. para transporte urbano) a pesar de que es económicamente sustentable
- ! Los tractores mantienen su popularidad con planificadores, políticos, donantes y usuarios a pesar de que la tractorización de pequeñas propiedades pocas veces es económicamente exitosa en sistemas de producción de pequeña escala, temporal y con cultivos tradicionales
- ! Tracción animal tiende a ser un tema olvidado en la educación, investigación y extensión. Existe la necesidad para una educación mejorada y capacitación sobre animales de trabajo
- ! Existe la necesidad de dar a la tracción animal una imagen moderna y relevante, y asegurar que los creadores de políticas la den atención seria

Redes

- ! Las redes de tracción animal ofrecen un gran potencial para el intercambio de información
- ! Redes (nacional o internacional) vinculan a la gente y crean una masa crítica para acción y apoyo profesional
- ! Redes deberían ser multi-disciplinarias y participativas con programas activos y responsabilidades delegadas
- ! Mucha información esta disponible de la Red Latinoamericana de Tracción Animal: RELATA
- ! La formación de una red nacional de tracción animal en Bolivia, podría proporcionar beneficios al vincular a todos los actores involucrados en el empleo y desarrollo de la potencia animal

RELATA

Red Latinoamericana de Tracción Animal
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