Appendix II

PROGRAMA DEL SEMINARIO TALLER

USO Y DISPONIBILIDAD DE LA TRACCIÓN ANIMAL EN SISTEMAS AGROPECUARIOS DE LADERAS

Lugar Chimboco-Km. 13 carretera Cochabamba-Chapare (Instalaciones del PROFOR).

Fecha y duración Del 8 al 9 de octubre de 1996

Punto de concentración: Día 8 de octubre- hrs 08:00 en CIFEMA-Av. Petrolera Km. 4, zona la Tamborada (para personas que no tienen transporte).

Participantes Agricultores, Técnicos e Investigadores.

Día 08/10/96

09:00 - 09:30	Inauguración
09:30 - 10:00	Inscripción de participantes
10:00 - 10:15	Organización y metodología
10:15 - 10:30	Objetivo del Seminario Taller
10:30 - 11:30	Presentación global resultados del diagnóstico.
11:30 - 12:30	Análisis de problemas (grupos).
12:30 - 13:30	Plenarias de presentación Generación árbol de problemas
13:30 - 14:30	Almuerzo
14:30 - 15:30	Objetivo General Finalidad del Objetivo General Objetivos específicos (grupos)
15:30 - 17:00	Resultados específicos (grupos)

Día 09/10/96

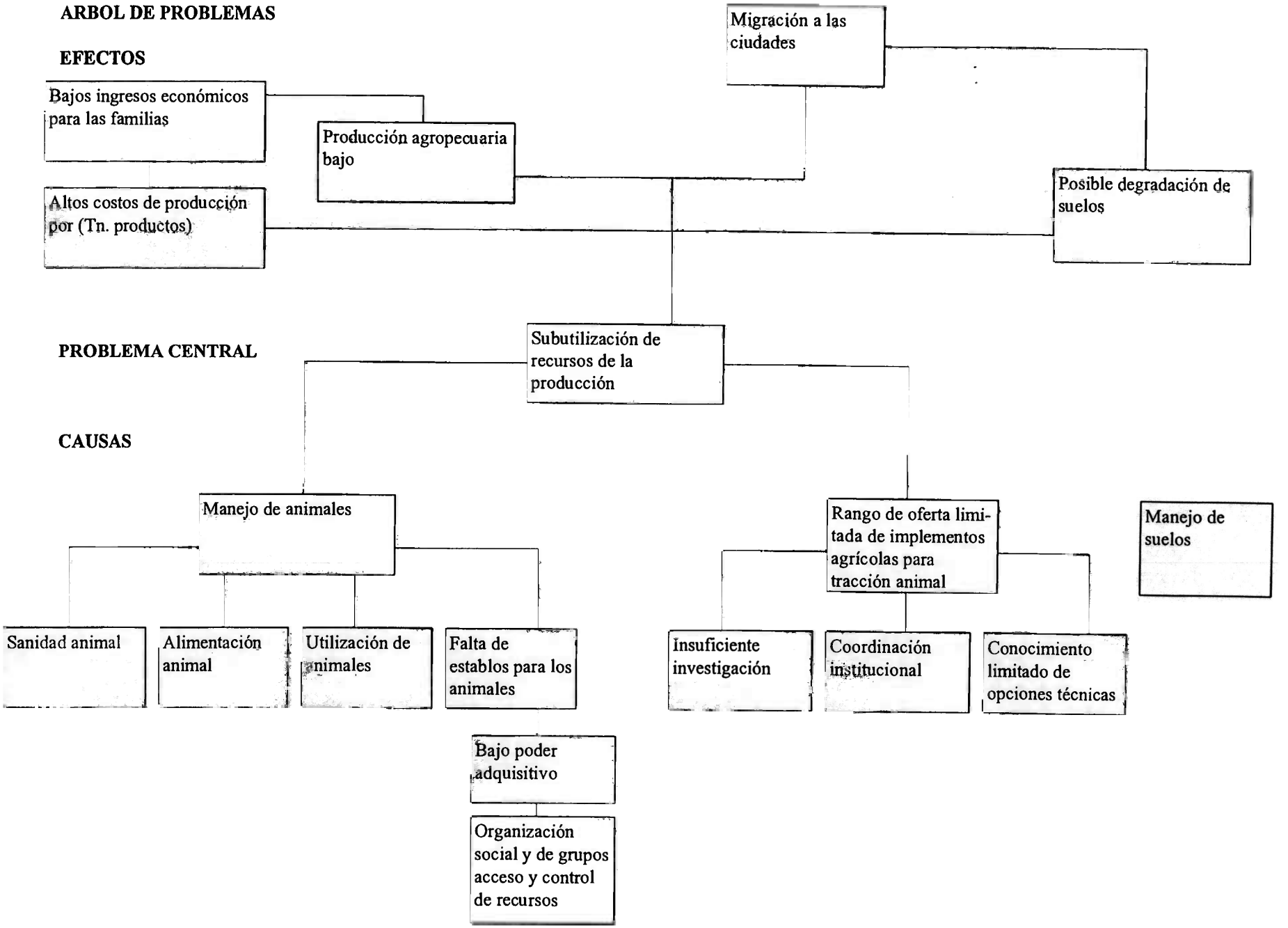
09:00 - 09:30	Presentación resultados específicos
09:30 - 10:00	Plenaria-priorización y selección de resultados
10:30 - 12:30	Actividades / supuestos
12:30 - 13:30	Presentación actividades
13:30 - 14:30	Almuerzo
14:30 - 16:30	Elaboración del marco-lógico
16:30 -	Clausura

INFORME DEL TALLER SOBRE

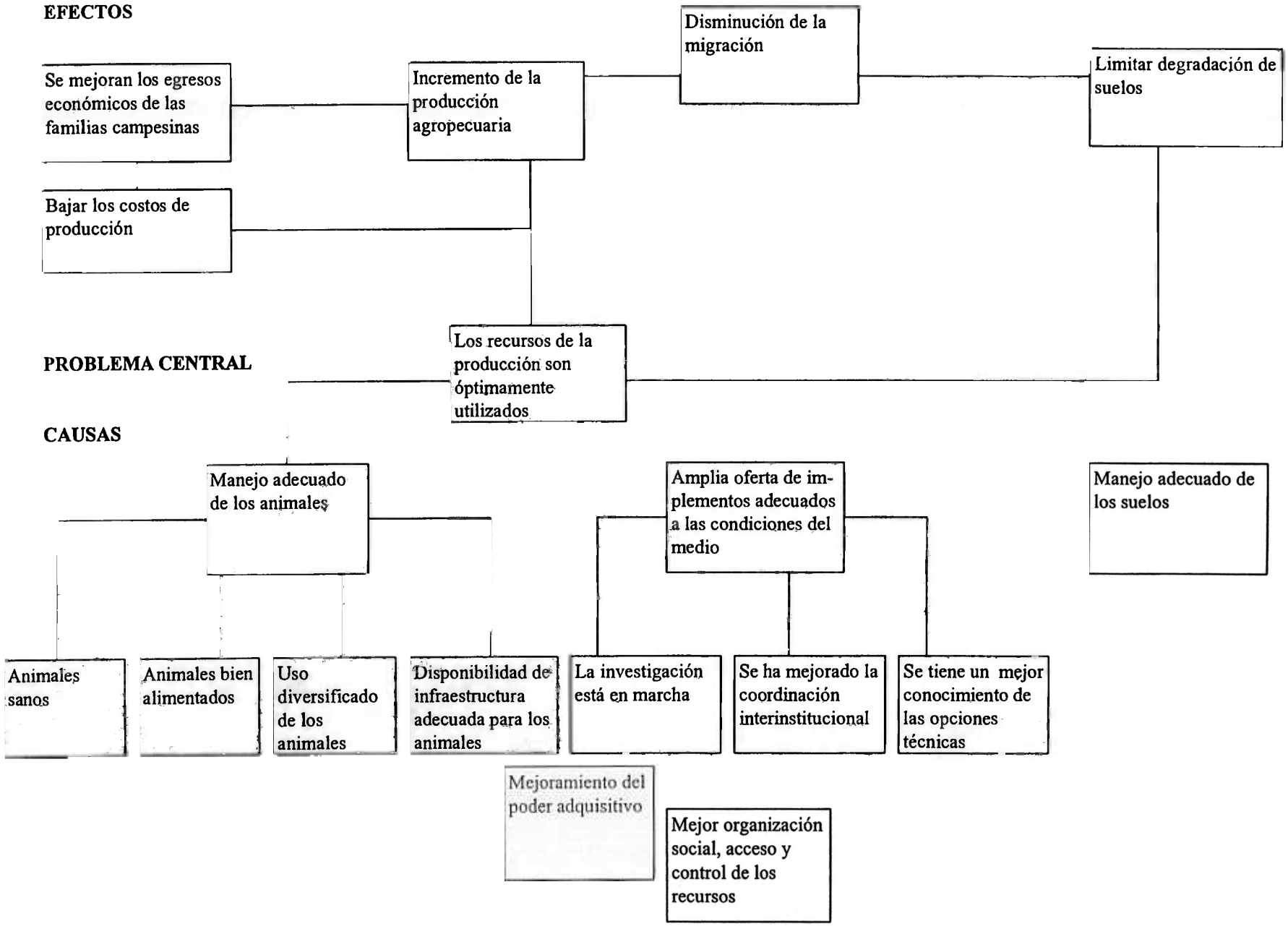
USO Y DISPONIBILIDAD DE LA TRACCION ANIMAL EN SISTEMAS AGROPECUARIOS DE LADERAS

Cochabamba, octubre de 1996

ARBOL DE PROBLEMAS



ARBOL DE OBJETIVOS



FINALIDAD EL PROYECTO

OBJETIVO SUPERIOR

Contribuir a mejorar la calidad de las familias campesinas y a la sostenibilidad de sus sistemas productivos.

OBJETIVO GENERAL

Optimizar el uso del Recurso pecuario en los sistemas productivos de laderas

OBJETIVO ESPECIFICO

Mejorar el aprovechamiento de la fuerza animal en los sistemas productivos de laderas

OBJETIVO ESPECÍFICO Mejorar el aprovechamiento de la fuerza animal en los sistemas productivos de laderas				
RESULTADOS 1. Recomendaciones para un mejor manejo conservacionista del suelo y agua desarrollados, evaluados y difundidos. 1.1 Selección participativa de métodos de conservación de suelos y agua. . Equipos de labranza . Manejo 1.2 Evaluación de equipos de labranza y practicas de conservación de suelo y agua en ladera.	Organización de talleres y días de campo. Difusión Intercambios y visitas para aprender y difusión			
2.Equipos para los animales de transporte adecuados a las condiciones del medio, desarrolladas, validadas y difundidas. 2.1 Selección participativa de implementos/equipos de: transporte, sembradoras, cosechas. 2.2 Diseño, construcción y evaluación participativa de implementos agrícolas para animales de transporte.	Difusión de las opciones exitosas desde el punto de vista agricultor			

RESUMEN DE OBJETIVOS/ACTIVIDADES		INDICADORES	FUENTES DE VERIFICACIÓN	SUPUESTOS
3. Recomendaciones para el mejor manejo (salud, nutrición, utilización, infraestructura) de animales de transporte desarrollados, validados y difundidos. 3.1 Selección participativa de posibilidades apropiadas. . Sanidad . Producción y conservación en forraje . Uso de terreno para producción alimenticia. . Utilización de animales 3.2 Evaluación participativa. . Producción y conservación de forraje. . Uso de terreno para producción alimentaria. . Infraestructura. . Utilización de animales				

10.08.96

SEMINARIO NRI-CIFEMA
INSTITUCIONES

No.	NOMBRES Y APELLIDOS	INSTITUCIONES DIRECCION		LUGAR DE TRABAJO	GRUPO
1	Cesar S. Montaño C.	VISION MUNDIAL	Telf. 69022	Capinota	1
2	Darwin Fuentes A.	VISON MUNDIAL		Capinota	2
3	Raúl Nuñez	ASAR	Telf. 25468	Arque-Tapacari	1
4	Jaime Garcìa R.	ASAR	Telf. 25468	Santiváñez	2
5	Pablo Mamani R.	PROINPA	Telf.49013	Tiraque-Toralapa	1
6	Ricardo Vera A.	ASAR	Telf. 25468	Independencia	2
7	Omar Torrez A.	ASAR	Telf. 25468	Arque Tapacari	3
8	Humberto R. Moya Guzmán	PROINPA	Telf.49013	Tiraque-Toralapa	2
9	René Pereira Romero	PROINPA	Telf.49013	Tiraque-Toralapa	3
10	Felix Rodriguez V.	PROY. LADERAS		Tiraque-Sacabamba	
11	Teófilo Villarroel	ASAR	Telf. 25468	Tapacari	3
12	Rómulo Caro C.	ASAR	Telf. 25468	Morochata	3
13	Rudy Tórrez T.	PROINPA		Morochata	2

14	Paul de Roover	EX-FAO		Nil (Tiquipaya)	1
15	Daniel Velasco	CIFEMA		Nacional	1
16	Leonardo Zambrana	CIFEMA	Telf. 37404	Nacional	2
17	Valeria Nelson	NRI	Telf.00441634-880088	Desarrollo social	2
18	Jaime Andrade	CIFEMA	Telf. 21132	Nacional	2
19	Oscar Cadena	CIFEMA		Tiraque, Morochata, Capinota	3
20	Jeroen Dijkman	FAO	+39 652252453	Roma-Italia	3
21	Emigdio Céspedes	PROY. LADERAS		FCAPFyV	2
22	Salomón Pastelo	CEPROCA		Capinota	3
23	Jaime Mendoza	CIFEMA	Telf.25515-34994	Cochabamba	3
24	Brian Sims	SRI/ODA		Mundo	3
25	Robert Paterson	NRI		Bolivia, Africa	1
26	René Flores	NRI-CIFEMA			3
27	José Gómez	CIFEMA		A nivel nacional	1
28	Graham Thiele	IBTA-PROINPA	Telf. 49013	Nacional	3

10.08.96

SEMINARIO NRI-CIFEMA
COMUNARIOS

N°	N O M B R E	COMUNIDAD	ZONA	GRUPO
	Gregorio Vegamonte	San Isidro Piusilla	Morochata	1
	Feliciano Vegamonte	San Isisdro Piusilla	Morochata	2
	Claudio López	San Isidro Piusilla	Morochata	2
	Willy Córdova	San Isisdro Piusilla	Morochata	1
	Fausto López	Sarco Bamba	Capinota	1
	Angel Gutiérrez	Sarco Bamba	Capinota	1
	Demetrio Mamani	Sarco K'uchu	Capinota	2
	José Galindo	Sarco K'uchu	Capinota	3
	Patricio Galindo	Kolque Joya	Tiraque	1
	Juan Rojas	Boqueron K'asa	Tiraque	2
	Antonio Villarroel	Boqueron K'asa	Tiraque	3

Appendix III

RD1 4/95

OVERSEAS DEVELOPMENT ADMINISTRATION

STRATEGY FOR RESEARCH ON RENEWABLE NATURAL RESOURCES

Project Numbers		*File Number*
NRRD	*NRI*	

Project Title

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

RESEARCH AND DEVELOPMENT

FUNDING APPLICATION

AND

PROJECT MEMORANDUM FORM

Note: THE FORM MUST BE COMPLETED TAKING INTO ACCOUNT THE NOTES ON COMPLETION OF ODA PROJECT MEMORANDUM FORMS

Country: Bolivia FILE REF:

Proj. TITLE (MAX 60 CHARS): Draught animal power in hillside farming systems

PROJECT DESCRIPTION - WHAT PROJECT IS DESIGNED TO ACHIEVE (MAX 3 LINES):

The project is designed to improve the exploitation of animal power in hillside production systems. To achieve this aim, the project will produce recommendations for improved working animal management, develop appropriate equipment and advance soil and water conservation measures.

	COMMITMENT (£)	
	TOTAL COSTS	LOCAL COSTS
ODA TC:	251,672	121,838

Is PROJECT COFINANCED WITH OTHER DONORS? (Y OR N): N

IF YES, ENTER TOTAL PROJECT VALUE:

PERIOD OF ODA FUNDING FROM:01/04/97 TO:31/03/00

ECON SECTOR CODE:

ESC DESCRIPTION:

POLICY MAKERS (mandatory for projects over £100,000)

Priority Objectives

01	ECONOMIC LIBERALISATION	:	10	ILLICIT DRUG CONTROL
02	ENHANCING PRODUCTIVE CAPACITY	:	11	HIV/AIDS
03	GOOD GOVERNMENT	:	12	URBAN DEVELOPMENT
04	POVERTY REDUCTION	:	13	PRIVATE SECTOR DEVELOPMENT
05	HUMAN DEVELOPMENT - EDUCATION	:	14	TECHNOLOGY DEVELOPMENT AND RESEARCH
06	HUMAN DEVELOPMENT - HEALTH	:	**Rio Markers**	
07	HUMAN DEVELOPMENT - CHILDREN BY CHOICE:		15	ENERGY EFFICIENCY
08	WOMEN IN DEVELOPMENT	:	16	SUSTAINABLE FOREST M'GMENT
09	ENVIRONMENT	:	17	BIODIVERSITY

APPROVAL DATE: APPROVAL LEVEL:

DATE PROJECT DOCUMENTS SIGNED:

I approve this project as described in this document and confirm that the commitment, economic sector, policy markers and associates have been checked for accuracy in line with the PIMS guidance.

Signed: ---------- Name: ---------- Date: ----------

SECTION A: KEY INFORMATION

Project Title

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

Abbreviated Title:

Management of Draught Animals in Hillside Farming Systems

2. **Is the research strategic~~strategic~~/adaptive?** (delete as appropriate)

3. **Project Summary** (maximum 100 words)

Participatory rural appraisals have identified draught animal husbandry (animal health, feeding, diversification of animal use and animal housing), implements (transport, soil cultivation, seeding, weeding and harvesting) and soil and water conservation (equipment and practices linked to fodder production) as major limiting factors in farming systems within the target area. Using participatory methodologies the project will select and evaluate appropriate technologies to address these constraints. Project objectives will be achieved in conjunction with local institutes and in collaboration with other ODA funded projects.

4. **Keywords** (including subject, species, countries etc.)

Bolivia, Hillsides, Participatory Research, Livestock Production, Animal Traction, Animal Husbandry, Implements, Soil and Water Conservation, Adaptive Research, Farming Systems.

5. **RNRRS Programme**

Livestock Production

6. **RNRRS PRODUCTION SYSTEM**

Hillside

7. **Project Goal (include RNRRS Programme Purpose where appropriate)**

Performance of livestock (including draught animals) in forest/agriculture interface and hillside (crop/livestock or livestock) production systems improved.

8. **Geographic Focus**

Bolivia

9. **Commodity Base**

Livestock

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Programa de Investigación de la Papa (PROINPA)
Man Cesped No. 0293
Casilla Postal 4285
Tel: +591 42 49013 Fax: +591 42 45708 eMail: proinpa@papa.bol

Ing. B. Tammes; Ing. O. Tapia Rojas
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Tel/Fax: +591 42 43328

Dr Paul de Roover
Casilla postal 5309
Cochabamba, Bolivia
Tel/Fax: +591 42 87358

Project location Cochabamba Department of Bolivia

3. **If the project is located overseas or if there is an overseas collaborator, has the approval of the overseas government been obtained? If so, provide details.**

Letter of approval is attached as annex 1.

14. **Starting and finishing dates** April 1997 to March 2000 (3 years)

ATTACH THE PROJECT LOGICAL FRAMEWORK

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

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

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

SECTION B: DEMAND, UPTAKE AND GEOGRAPHIC FOCUS

15a **What is the project's purpose** (maximum 50 words)?

The project addresses output 5 of the Forest-Agriculture Interface and Hillsides Systems: In one hillside and one forest-agriculture interface system, energy balance of draught animals in traditional work assessed in relation to species, animal size and physiological status, environmental variability, soil type and structure and machinery options, and appropriate feeding strategies developed and promoted.

15b **What developmental problems or needs is the project aimed at?**

Small size of holdings and sloping lands, as well as finance, rule out the introduction of tractors in the project area. Animal traction is widely used for land preparation and some other agricultural practices. Farmers perceive that the main problems associated with the use of working animals include poor animal husbandry techniques and deficient implements. Land degradation is resulting from inappropriate tillage techniques on sloping land. Under these constraints, falling agricultural production undermines the livelihood of the inhabitants. This, combined with population growth, is contributing to emigration from the area with consequent problems in other parts of the country, principally in the cities of Cochabamba and Santa Cruz, which have experienced extremely high growth rates over the past two decades.

15 c **What is the evidence for the demand for the research?**

The project will address demands that are directly associated with the ineffective and inefficient use of draught animal power resources leading to a reduction in crop yield, erosion and sub-optimal livestock production. It is widely recognized that there is a need to develop low-cost methods of reducing soil erosion and increasing soil fertility that have applicability over a wide range of hillside environments. In addition, soil erosion is recognized as a major cause of loss of soil fertility in several agro-ecological zones of the Andean valleys, resulting over many years in major deforestation as increasingly more marginal land is used for crop production.

In the ODA funded preparatory study, participatory rural appraisals were carried out in six communities in the Cochabamba area. These appraisals, together with a confirmatory workshop attended by community representatives, intermediate users and scientists, clearly indicated the need for research into working animal husbandry, implements for animal traction and soil and water conservation techniques for the hillside environment.

15d **What will the project contribute to resolving these problems or needs and over what time-scale?**

The project will improve the efficiency of use and diversify the utilisation of draught animal power by smallholder hillside farmers. It will develop improved animal management through activities in animal health, fodder production, conservation and utilization and housing. It will also develop improved equipment for use by working animals and this will address the wider problems of degradation of natural resources, principally land, soil and water, through unsuitable agricultural practices. These activities will be conducted over a three year period.

15e **What is the geographic focus of the project?**

The direct geographic focus of the project is the mid altitude Andean valleys of Bolivia. Subsequent research will indirectly benefit other countries having similar agro-ecological conditions in Latin America and elsewhere.

15f **Which are the identified target institutions?**

The intended users are:
(a) Smallholder farming families in communities in the Cochabamba area of Bolivia, associated with or affected by the project.
(b) Farmer associations
(c) Local institutes and NGOs (UMSS, CIFEMA, PROINPA, CIPCA, DESEC, AZAR)
(d) NRSP hillside project
(e) Research and development organisations and networks in Bolivia and other countries in Latin America and elsewhere

15g **What are the proposed promotion pathways for the uptake of the project outputs?**

i) Market studies carried out for project outputs.

The participatory appraisals and workshop carried out in the ODA funded preparatory study (R6605) have defined the farmer-felt prioritized needs relevant to draught animals and their use (see annex 2 for PRA reports; final technical report in preparation). This is supported by the obvious interest shown by NGOs in the region.

ii) How outputs will be made available to intended users.

Farmers and collaborating institutions will be directly involved in participatory selection and evaluation of technologies tested by the project. Contacts will be made with animal traction networks to share experiences and research results. There will be complementarity with other NRR, NRSP and ODA bilateral inputs. Other users will have access to project outputs via the normal dissemination mechanisms listed under (v).

iii) Further stages needed to develop outputs.

Methodologies developed by the project will be evaluated over the course of three years. This will allow for recommendations to be developed and validated and although the period is short, some will be disseminated during this time. If necessary, further adaptive research can be undertaken by local organizations.

iv) How will further stages be carried out and paid for.

A continuing role for UMSS, through CIFEMA, together with other participating NGOs and collaborating organizations will ensure long term validation of project results.

v) Dissemination mechanisms.

Dissemination will be carried out through:
(a) Participatory involvement of farmers;
(b) Direct involvement of local institutes and NGOs
(c) Exchange visits, field days and workshops
(d) Existing mass media outlets
(e) Participatory evaluation reports
(f) Scientific papers for journals and international workshops
(g) Occasional publications

15h **Who will the beneficiaries be and are there any groups who will be disadvantaged by the application of the research findings?**

Direct beneficiaries of the project will be smallholder farming families in the Cochabamba area of Bolivia. This will include those actively involved in the research process, as well as those reached through dissemination of project results. Information will be made directly available to collaborating local institutes, NGOs and other projects. Students of UMSS will benefit through the availability of thesis projects and staff of collaborating institutes will receive training and exposure to participatory methods. The wider community will benefit through reduced environmental degradation. The research will indirectly benefit other countries in Latin America and elsewhere, with hillside farming communities in similar agro-ecological zones.

No groups will be disadvantaged by the research.

16 **Is this proposal a continuation or extension of work already funded by ODA?**

Yes, a direct extension of:
Preparatory study on the availability and use of draught animal power in the middle Andean hill farming systems of Bolivia.
Reference No.: ODA project code: R6605, NRI project code: A0511

In addition, the project will work closely with and draw on scientific information from the following projects:

NRSP Hillside project:
Strategies for improved soil and water conservation practices in hillside production systems in the Andean valleys of Bolivia
Reference No.: ODA project code: R6621

RNRRS LPP project:
Strategies for integrating and optimizing livestock production in forest margin farming systems
Reference No.: NRI project code: A0563

NRSP/CPP projects:
Sustainable agriculture in forest margins
Reference No: ODA Project codes: R6165CB and R6008CB, NRI Project codes: F0052 (Natural Resources System Programme) and F0057 (Crop Protection Programme), both funded for 4 years from April 1995.

SECTION C: SCIENTIFIC BACKGROUND

17. **What work has previously been done or is currently being pursued towards the purpose, outputs and activities of the project? (A review of literature should be attached)**

In many less developed countries draught animal power continues to make an important contribution to rural and urban economies. In fields that tractors cannot reach, such as terraced hillsides and on farms where the size and scale of enterprise, as well as finance, rule out tractors, animal power is the farmer's only means of cultivating the land other than by hand.

Until relatively recently, draught animal research was considered a neglected subject (Smith, 1981). The realisation of the continued importance of draught animals, however, has stimulated interest in research. Reviews by Petheram et al. (1989) and Starkey *et al.* (1991) indicate the increase in institutes and organisations working on draught animals. The majority of this work, however, has been carried out in lowland sub-Saharan Africa and Southeast Asia and as a result few data are available on the role of draught animals within hillside farming systems.

In a recently published report on the role of animal traction in hill-farming systems in the Dominican Republic (Starkey, 1995), it was observed that farmer felt constraints ranged from a lack of feed resources and the access and availability of draught animals to a lack of suitable implements and spare parts. Similar observations have been reported from other hillside systems (Gatenby *et al.*,1990; Pariyar and Singh, 1995.) and the project area (Rist, 1991; Zimmerer, 1993)

To overcome the lack of information, a preparatory study was carried out in the middle Andean hill farming systems of Bolivia to describe and analyse the prioritised factors affecting draught animal power use. The Participatory Rural Appraisal (PRA), organised in collaboration with CIFEMA, the FCAPFyV of the UMSS and a number of NGOs, was conducted in six communities in three provinces of the Cochabamba region. The three provinces were chosen as they represent the broad spectrum of agro-ecological zones, socio-economic circumstances and draught animal-usage within the region. The PRA used informal interviewing techniques and other PRA methods (transects, historical transects, community mapping, seasonal calendars, mobility maps, resource flow diagrams, preference and problem ranking) to obtain basic village data, historical analysis of the communities, farming and livelyhood system analysis and livestock and animal traction sub-system data (see annex 2).

The PRAs, together with a confirmatory workshop attended by community representatives, intermediate users and scientists, clearly indicated the need for research into working-animal management, implements for animal traction and soil and water conservation techniques for the hillside environment. The currently proposed project will address these specific issues within the established collaborative framework of CIFEMA, UMSS, NGOs and the NRSP funded hillside project. In addition, the project will have access and add to technologies developed and evaluated in the region through its association with the newly established Red Latin Americana Tracción Animal (RELATA).

SECTION C: SCIENTIFIC BACKGROUND

17 **Continued.**

References

Gatenby, R.M., Thapa, B and Shrestha, N.P. (eds.). 1990. Livestock in the hills of Nepal. Proceedings of the second livestock workshop held at Pakhribas Agricultural Centre, 11-16 March 1990.

Pariyar, M.P. and Singh, G. 1995. Farm mechanisation in Nepal. *Agricultural Mechanisation in Asia, Africa and Latin America*, **Vol.26 No.2**, 55-61.

Petheram, R.J, Goe, M.R. and Abiye Astatke. 1989. *Approaches to research on draught animal power in Indonesia, Ethiopia and Australia*. Graduate School of Tropical Veterinary Science, James Cook University, Townsville, Australia.

Rist, S. 1991. Participation, indigenous knowledge and trees. *Forests, Trees and People Newsletter* **13**, 30-36.

Smith, A. J. 1981. Draught animal research. A neglected subject. *World Animal Review*, **40**, 41-48.

Starkey, P. H., Sirak Teklu and Goe, M.R. 1991. Animal Traction. An annotated bibliographic database. ILCA, Addis Ababa.

Starkey, P.H. 1995. Animal traction and sustainable agriculture in the Dominican Republic. Consultancy report prepared for Winrock International Institute for Agricultural Development. 20p.

Zimmerer, K. S. 1993. Soil erosion and labour shortages in the Andes with special reference to Bolivia, 1953-91: Implications for 'conservation-with-development'. World Development, **21(10)**, 1659-1675.

SECTION D: OUTPUTS AND ACTIVITIES

18a **What are the outputs of the project?**

- Recommendations for improved management of working animals (feed resources, nutrition, use, health, 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.

18b **What are the objectively verifiable indicators for the outputs?**

- Recommendations for improved work animal management produced (from April 1998);
- Recommendations for improved work animal management evaluated and disseminated (from April 1999);
- At least 5 pieces of equipment for working animals developed(from April 1998);
- At least 5 pieces of equipment for working animals evaluated and disseminated (from April 1999);
- Recommendations for improved soil and water management produced (from April 1998);
- Recommendations for improved soil and water management evaluated and disseminated (from April 1999).

18c **What are the means of verification of the outputs?**

- Project periodic reports;
- Participatory evaluation reports;
- Workshop proceedings;
- Project final report;
- Scientific papers.

18d **What are the expected environmental impacts? (beneficial, harmful, neutral)**

i) Direct

The project is expected to have a beneficial effect on land husbandry through reduced land degradation from over grazing and possible improved cultivation techniques. In addition, it is expected to have a direct beneficial impact on the conservation of soils, water and bio-diversity resources within the local farming system.

ii) Indirect

The research will indirectly have beneficial environmental impact in other countries in Latin America and elsewhere within hillside farming communities in similar agro-ecological zones.

19a **Describe the project activities**

Activities of the project will be participatory research conducted by the project manager, consultants, local institutes, development organisations and local thesis students in close collaboration with the NRSP funded hillside project in Cochabamba region. The research will be carried out in Bolivia in the six communities involved in the preparatory study and will mainly consist of participatory selection and evaluation of improved animal husbandry, implements for animal traction and technologies for improved soil and water conservation. Farming households will be directly involved in all phases of the work. It will draw heavily on the experiences and results of previous and current ODA funded research and bi-lateral projects.

During all the participatory selection exercises, lists of available technologies will be drawn up by the scientists. Subsequently, meetings will be organised were they will be presented to the farming communities and the appropriate technologies selected.

Activity 1: Animal husbandry

1.1 Participatory selection of appropriate technical solutions for:

1.1.1 Animal health: PRA findings point to a lack of both access to and knowledge about existing veterinary practices. Opportunities to address this situation (e.g. training of para-vets, revolving fund for veterinary medicines) will be investigated in close collaboration with NGOs.

1.1.2 Fodder production, conservation and conservation: From the range of techniques of fodder production and conservation available internationally (e.g. new species, methods of silage making), promising methodologies will be selected for evaluation.

1.1.3 Land-use technologies for feed production: There exists the possibility of utilizing unexploited niches for fodder production in conjunction with other uses such as soil fertility improvement and erosion control.

1.1.4 Animal housing: From the range of low cost animal housing available, appropriate designs will be selected to provide shelter and to facilitate collection and use of the manure produced.

1.1.5 Diversification of animal use: Culturally acceptable and technically feasible options for the wider use of work animals will be identified (e.g. donkeys for secondary tillage in vegetable crops or the use of oxen for root crop harvesting to replace manual labour).

1.2 Participatory evaluation of selected technologies for:

1.2.1 Fodder production, conservation and utilization: The selected techniques will be evaluated in on-farm trials on farmer and researcher set criteria. These may include an assessment of the labour requirements, compatibility with the existing systems and other costs and benefits. Bio-physical measurements will include seasonal and year round fodder yields and animal productivity (e.g. liveweight gain, condition scoring, yield of manure). The results obtained will be compared to similar measurements made on farms without the intervention.

1.2.2 Land use technologies for feed production: as in 1.2.1

19a **Describe the project activities (continued)**

1.2.3 Animal housing: The selected types of low-cost housing will be constructed on-farm and evaluated on farmer and researcher set criteria. These will include an assessment of the costs and benefits. (e.g. change in ease and efficiency of feeding, improved fodder conservation, manure collection and veterinary care).

1.2.4 Diversification of animal use: The available work animal species will be evaluated for existing and newly identified tasks in on-farm trials based on farmer and researcher criteria. These will include ease of training and adaptability, work rates and work quality and crop yield and quality. Social and economic criteria will also be included.

Activity 2: Draught animal equipment

2.1 Participatory selection of appropriate animal equipment: From the internationally available range of draught animal equipment for transport, soil cultivation, seeding, weeding and harvesting appropriate implements will be selected in conjunction with farmers.

2.2 Participatory evaluation of equipment: Where there is adequate existing equipment available in other regions of the world this will be evaluated in on-farm trials. Where necessary, existing equipment will be adapted and/or new equipment will be designed and constructed for subsequent on-farm evaluation. Evaluation criteria will include technical performance (draught requirements, work rates and work quality) and social and economic evaluations.

Activity 3. Soil and water conservation

3.1 Participatory selection of appropriate technologies

3.1.1 Soil cultivation equipment: From the internationally available range of tillage equipment designed to conserve soil and water, appropriate implements will be selected for evaluation. Where no suitable equipment is available, prototypes will be designed and constructed. Evaluation procedures will be similar to those described in section 2.2.

3.1.2 Soil conservation practices: From the internationally available range of conservation practices linked with fodder production, suitable alternatives will be selected for evaluation. These will include practices being developed by the Hillsides project (e.g. live barriers, cover crops and crop associations).

3.2 Participatory evaluation of appropriate technologies: The selected equipment and practices will be evaluated for soil and water conservation efficiency, fodder production and farmer acceptability in on-farm trials on hillsides. The evaluation criteria for soil and water conservation will be similar to those used by the Hillsides Project (e.g. comparative losses of soil, moisture and nutrients). Fodder assessment will be as described in section 1.2.

Activity 4. Dissemination

4.1 Dissemination to farmers and intermediate users: Project results will be shared by and with the communities and NGOs involved through a series of workshops, field days and exchange visits. A wider audience will be reached through the provision of information to existing mass media.

4.2 Documentation: The project results will be documented in a series of technical reports, seminar proceedings and scientific papers.

19b **What factors could prevent the attainment of:**

i) Planned Activities

- Collaborating institutions withdraw facilities and funding;
- Lack of farmer and NGO participation;
- Security situation in rural areas deteriorates.
- Extreme climatic conditions

ii) Outputs

- Poor continuity of local collaborating staff;
- Appropriate technologies cannot be evaluated and disseminated within the project time-frame;
- Local institutions do not invest in the dissemination of project results.

iii) Project purpose

- Results of the study are not widely applicable to other hillside systems;
- Funds for work proposed are not made available at the start of FY 1997/98;
- Lack of close collaboration with existing complementary research projects and local institutions.

iv) Project Goal

- The lack of a positive enabling environment (policies, institutions, markets, incentives) for widespread adoption of new technologies and strategies;
- Target institutions do not invest resources in the uptake and application of research products in hillside agriculture systems;
- Complementary research results to achieve project goal are not available.

20 **Complete a bar chart or attach milestone charts over the life of the project**

Year ending 31.03.98

	A	M	J	J	A	S	O	N	D	J	F	M
Activity 1.1		X	X	X	X	X						
Activity 1.2									X	X	X	X
Activity 2.1		X	X	X	X	X						
Activity 2.2				X	X	X	X	X	X	X	X	X
Activity 3.1		X	X	X	X	X						
Activity 3.2								X	X	X	X	X

Overseas travel	To	A	M	J	J	A	S	O	N	D	J	F	M
Sims	Bolivia	X	X										
Romney	Bolivia						X						
Paterson	Bolivia							X					
Dijkman	Bolivia	X	X						X				

Milestone	**Related to activity**	**Planned date of delivery**
1. Animal husbandry, equipment, soil and water conservation technologies selected	1, 2.1, 3.1	sept '97
2. Planting/establishment of on-farm trials	.2, 3.2	dec '97
3. Acquiring and testing available equipment	2.2	mar '98

Year ending 31.03.99

	A	M	J	J	A	S	O	N	D	J	F	M
Activity 1.2	X	X	X	X	X	X	X	X	X	X	X	X
Activity 2.2	X	X	X	X	X	X	X	X	X	X	X	X
Activity 3.2	X	X	X	X	X	X	X	X	X	X	X	X
Activity 4.1							X		X			X
Activity 4.2												X

Overseas travel	**To**	A	M	J	J	A	S	O	N	D	J	F	M
Sims	Bolivia					X	X					X	
Romney	Bolivia				X								
Paterson	Bolivia								X				
Dijkman	Bolivia		X	X									X

Milestone	**Related to activity**	**Planned date of delivery**
1. Participatory evaluation of on-farm trials	1.2, 2.2, 3.2	sept '98
2. Planting/establishment of on-farm trials	1.2, 3.2	dec '98
3. Design, construction and testing of new equipment	2.2	mar '99
4. Workshops, field days exchanges organized	4.1	mar '99
5. Technical reports	2.2	mar '99

Year ending 31.03.00

	A	M	J	J	A	S	O	N	D	J	F	M
Activity 1.2	X	X	X	X	X	X	X					
Activity 2.2	X	X	X	X	X	X	X					
Activity 3.2	X	X	X	X	X	X	X					
Activity 4.1	X			X			X			X	X	
Activity 4.2							X	X	X	X	X	X

Overseas travel	To	A	M	J	J	A	S	O	N	D	J	F	M
Sims	Bolivia						X	X				X	X
Romney	Bolivia								X				
Paterson	Bolivia			X									
Dijkman	Bolivia	X							X	X			X

Milestone	Related to activity	Planned date of delivery
1. Participatory evaluation	1.2, 2.2, 3.2	sept '99
2. Organisation of workshops, field days and exchanges	4.1	sept '99
3. Scientific papers	4.2	mar '00
4. Project final report	4.2	mar '00

SECTION E: FINANCIAL INFORMATION

21a **Total funding requested from ODA**

251,672

21b **Summary of funding (£) requested from ODA to be shown by ODA financial years 1 April to 31 March** (also complete Section 22)

YEAR	1997/98	1998/99	1999/00
Staff Costs	13,989	14,129	14,268
Overheads	15,116	15,268	15,420
Equipment	21,050	3,930	3,573
Overseas Travel	13,250	13,675	14,119
Miscellaneous	27,560	31,438	34,887
VAT			
TOTAL COSTS	90,965	78,440	82,267

Will your organisation charge ODA Value Added Tax? No

VAT registration number

Contributions from other organisations towards the costs of the project

CIFEMA has agreed to cover salary costs for one full-time local agricultural engineer, agricultural economist and secretarial and administrative support. In addition, they will provide the project with office accomodation and a workshop. The UMSS has agreed to provide statistical support and thesis students who will be carrying out research for the project as part of their degree course. The project will collaborate and integrate with the NRSP Hillside project (£250,000 over three years), the RNRRS LPP project (£250.000 over 3.5 years) and NRSP/CPP project (£450.000 over four years)

21e **If this proposal is being submitted elsewhere for funding state the organisation and when a decision is expected**

Not applicable

SECTION E: FINANCIAL INFORMATION (Continued)

22a **Staff Costs**

SALARY COSTS: (Salary, National Insurance, and Superannuating contributions should be shown separately for each person). **All likely salary increases and inflation must be allowed for.** If staff are on incremental scales, give incremental date for each staff category.

Name and Percentage of Time Charged For	days	PERIOD 1997/98	PERIOD 1998/99	PERIOD 1999/00
Mr B Sims (21.1; 21.1; 21.1%)	45, 45, 45			
Salary		7,786	7,864	7,942
ERNIC		608	614	620
ASLC		1,092	1,103	1,114
Dr D Romney (7; 7; 7%)	15, 15, 15			
Salary		1,543	1,558	1,574
ERNIC		121	122	123
ASLC		216	218	220
Dr R Paterson (7; 7; 7%)	15, 15, 15			
Salary		2,153	2,175	2,196
ERNIC		168	170	171
ASLC		302	305	308
SUB-TOTALS		13,989	14,129	14,268
VAT				
TOTALS		13,989	14,129	14,268

In addition to the staff paid from this budget, the project will also be able to use the services of Dr Dijkman from FAO for a period of 10 weeks a year. In addition, CIFEMA and UMSS will provide the staff mentioned in section 21d. The project will further have access to staff paid for out of the Hillside programme.

22b **Overheads**

This section must include any overheads stating method of calculation.

DETAILS		1997/98	1998/99	1999/00
Mr B Sims	87 % of staff costs	8,280	8,363	8,446
Dr D Romney	140 % of staff costs	3,161	3,193	3,225
Dr R Paterson	140 % of staff costs	3,675	3,712	3,749
SUB-TOTALS		15,116	15,268	15,420
VAT				
TOTALS		15,116	15,268	15,420

SECTION E: FINANCIAL INFORMATION (Continued)

22c Capital Equipment

It is assumed that the laboratory where the work is to be done is adequately equipped with the basic tools to undertake the work. In the event of additional equipment being required, it must be project-specific and full justification must be given for its purchase. Equipment purchased from ODA funds should be of BRITISH manufacture. If non-British goods are required NRRD should be notified.

All non-expendable items which cost £500 or more to purchase (excluding VAT) remain the property of the Overseas Development Administration and must not be disposed of without the prior permission of NRRD. No items must exceed £25,000.

Detailed specifications should be given for all items including details of suppliers and catalogue numbers where known and the financial year in which they will be required.

EQUIPMENT	PERIOD 1997/98	PERIOD 1998/99	PERIOD 1999/00
Land Rover pick-up or equivalent	13,000		
Computer + laser printer	2,000		
Ergometer	3,000		
Field experiment materials (balances, tape measures, seed, planting materials etc.)	1,750	2,500	2,000
Stationary and other office supplies	1,300	1,430	1,573
SUB-TOTALS	21,050	3,930	3,573
VAT			
TOTALS	21,050	3,930	3,573

The budgeted pick-up is needed as CIFEMA's current two vehicles are in continuous use for their extension programme. A lack of transport or infrequent access to a vehicle would significantly impair the execution of the proposed work. CIFEMA is poorly equipped in terms of computers and printers and it would seriously restrict the data evaluation and general execution of the project if no full-time access to a computer and printer was available. The ergometer (Lawrence & Pearson, 1985) is needed to carry out measurements of draught force, work done and distance walked as part of the on-farm evaluation of equipment and draught animal performance.

Please itemise airfares (economy class), subsistence, etc.

DETAILS	PERIOD 1997/98	PERIOD 1998/99	PERIOD 1999/00
5 economy class airfares to Bolivia @ £1,500	7,500	7,875	8,269
T & S @ £175 per week	5,250	5,250	5,250
Incidental travel expenses	500	550	600
SUB-TOTALS	13,250	13,675	14,119
VAT			
TOTALS	13,250	13,675	14,119

The project will not have to pay for all staff travel as project personnel are also involved in other research projects in the area. The listed airfares will be used by Mr Sims (1); Dr Romney (1); Dr Patterson (1) and Dr Dijkman (2), In addition, rather than staying in hotel accomodation the project will rent an apartment in association with the hillside project (costs will be shared) to house expatriate staff during their project assignments.

22e **Miscellaneous** (see attached explanatory notes)

This section should include UK travel and all other costs not covered by 22a-22d.

DETAILS	PERIOD 1997/98	PERIOD 1998/99	PERIOD 1999/00
Local project leader @ £530 per month	6,360	6,678	7,012
Local Consultants:			
Dr J Bentley @ £500 per week	3,000	3,150	3,308
Dr P de Roover @ £650 per week	5,200	5,460	5,733
CIFEMA coordination	1,800	1,890	1,985
Occasional labour	2,600	2,730	2,867
Local staff *per diem*	2,000	2,100	2,205
Thesis students @ £1,300 per student/year	2,600	2,730	2,867
Transport running and maintenance costs	2,000	2,100	2,205
Rent apartment for expatriate staff lodging	2,000	2,100	2,205
Workshop		1,500	2,000
Publications		1,000	2,500
SUB-TOTALS	27,560	31,438	34,887
VAT			
TOTALS	27,560	31,438	34,887

The salary of the local project leader is based on a salary of US$700.00 per month (including insurance and other contributions), which is the same rate as the Hillside project pays their local project coordinator.

The local consultants (Dr Bentley and Dr de Roover) will each year carry out distinct pieces of project work on the socio-economic evaluation of the introduced technologies and the provision of animal health services, respectively.

The item for 'CIFEMA coordination' will pay for eMail, fax and telephone costs, as well as the acquisition of official documentation and validation of local staff contracts.

Occasional labour will cover costs associated with the employment of additional local staff on distinct pieces of on-farm project work. In addition, it will cover the need for additional administrative and secretarial back-up. Salaries have been calculated at the going rate of US$500.00 per month (including insurance and other contributions).

Local staff *per diem* has been calculated at the existing CIFEMA and UMSS rate of B$150/day (£20.00). The item will, hence, cover an estimated total of 100 days for all local staff on field assignments.

Although the UMSS will provide teaching and supervision of the thesis students, the project will pay the maintenance grant (currently @US$2000/student/year)

Transport running costs have been calculated at a costs of US$0.10/km, to cover fuel and maintenance costs. Based on the experience of the preparatory study a estimated total of 30.000 km is expected to be covered each year. Costs are relatively low as maintenance can be carried out in the CIFEMA workshop and the project will have to provide spare parts and fuel only.

Current rental prices in Cochabamba for a furnished apartment range between US$400.00 and US$600.00 per month. The listed item will, hence, cover half the cost of such an apartment as the other half will be paid by the Hillside project.

Listed expenditure for the organisation of workshops are based on the costs (conference room rental, materials, transport of delegates, board and lodging, publicity) of the workshop which was held during the preparatory study in Cochamba in October 1996.

The publication item will pay for the printing and distribution of workshop proceedings and other project documents.

Appendix IV

From beast of burden to multi-purpose power source: Changes in, and challenges for the utilisation of equines in Bolivia

Dijkman[1] and B. G

Chatham Maritime, Kent M
Research Institute *Bedford MK45 4HS, UK*

Abstrac

For many years, donkeys, together with horses and llamas, provided the only source of non-human transport in the Andean regions of Bolivia. This was mainly in their capacity as pack animals as, due to the nature of the terrain, carts had rarely been an option. Even today, with an ever extending network of all-weather roads, the principal use of carts in Bolivia remains localised in a few immigrant colonies in the eastern lowlands. The extensive road building projects, combined with increasing crop yields and development per se, have, however, had a dramatic impact on the use of equines. The bulk of the transport is currently provided by trucks and donkeys are, in most cases, used to carry cut fodder to the farm and agricultural produce to the road head. In areas were roads are still absent or impassable during the rainy season, donkeys and other pack animals still provide a vital life-line. Yet, with the continuing progress of road building projects, these areas are getting rarer each day. In this climate of change, efforts will have to be directed to the alternative employment of this valuable, but currently under-utilised, animal resource. Opportunities exist not only in the development of low-cost carts, but also in the use of donkeys for low draft tasks such as seeding and inter-row weeding and other agricultural tasks that are currently carried out by hand.

Introduction

The picture of long trails of pack animals inching their way down treacherous mountain paths still features strongly in tourist literature advertising dream-holidays in the Andean region of Latin America. In reality, however, this has become a rare sight nowadays. A combination of extensive road development projects, which have opened up previously isolated areas to motorised traffic, and increasing crop yields, in particular potatoes,the major cash crop, have significantly increased transport needs and possibilities in the region.

This paper presents part of the results of a Participatory Rural Appraisal (PRA) on the *availability, use and management of work animals in the middle Andean hills of Bolivia*, which was carried out between May and October of 1996 in six communities in three provinces (Capinota, Morochata, Tiraque) of Cochabamba Department in Bolivia. These provinces were selected as they represent the broad spectrum of agro-ecological zones, socio-economic circumstances and work animal usage within the region. During the PRA exercise, a checklist incorporating a variety of methods such as historical transects, community mapping, seasonal calendars, mobility maps, resource flow diagrams and matrix and problem ranking was used to obtain basic data on communities, history, farming and livelihood systems, livestock and animal traction sub-systems. The paper discusses the changes that have occurred in the use of donkeys in the region and, in addition, it analyses the opportunities that exist for the diversification of their use in this rapidly changing farming environment.

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The communities in which the PRAs were carried out; Sarcobamba and Sarco Kucho in Capinota, San Isidro and Puisilla in Morochata, and Kolque Joya and Boqueron K'asa in Tiraque. They are situated between 2300 and 3800 m above sea level with an average annual rainfall of 500 to 650 mm,with and mean temperatures between 11 and 15 °C. Size of landholding ranges from 0.5 to 5 ha. Whereas the differences in topography and micro-climate have obvious implications for the specific type of agricultural practices within the communities, potato, as is typical for the whole region, is the major cash and subsistence crop. Cereals (maize, barley, oats or wheat, depending on the altitude) form another main component of the cropping calendar which is further complemented with crops such as broad beans, carrots and onions. Livestock forms an integral part of all farming activities and is mainly used for the provision of traction (oxen) and household food and sale (pigs, chicken, sheep and dairy cattle). In addition, most households own a horse, donkeys and, at the higher elevations, llamas.

Donkeys: past and present

There are little past or current data on the number of donkeys available in the country. Equines are not listed in the chapter on animal production of the Secretaria Nacional de Agricultura y Ganaderia (SNAG, 1994), which reports on animals used for commercial meat production only. The FAO Production Yearbook (1996) has entries for horses, donkeys and mules, but these are at best rough guesstimates (Table 1). Moreover, hardly any attention is paid to this animal resource by Bolivian institutes or NGOs.
Donkeys and other pack animals used to be the only means of transport available in the area both for people and goods. Hence donkeys not only formed part of the essential lifeline with outside world, but they also constituted an integral part of many on and off-farm activities involving the need for transport.

[Insert table 1]

Following the Agricultural Reform Bill of 1954, when Bolivian peasants, who previously worked the land belonging to large landowners under a feudal system, acquired ownership rights to the land they were cultivating, the agricultural landscape has changed significantly (Bentley, 1996). Not only did peasant farmers enter into the market economy, but also the agricultural development in the country now focused on the millions of subsistence farmers that had to provide the country with food. The opening up of the Andean hinterland by an expanding network of roads, has also meant that NGOs and other development organisations can now easily access communities that were previously virtually beyond reach. Through the improved accessibility and availability of information, farming communities were able to obtain technologies such as chemical fertilisers, phyto-sanitary chemicals and improved

potato varieties. These technologies have had a major impact on the production of this crop with yields, in some cases, increasing more than tenfold. As a result, families that previously produced *c.* 1000 kg of potatoes of which about 800 kg was used for auto-consumption whilst the remainder was marketed, now may have several tonnes to sell. Marketing these amounts by pack animals would be a long and tedious process and, as the extension of the road network also opened up the communities to motorised transport, most of this type of transport is currently done by truck or pick-up. Moreover, the adoption of more sophisticated attitudes in the larger cities of Bolivia has deemed the presence of large animals and the accompanying manure unacceptable and equine transport is currently all but banned from urban areas such as Cochabamba. In spite of all these changes the majority of the rural households still own one or two donkeys. Whilst they can be seen tied-up near the homestead or grazing for the majority of the day, they are still employed for operations such as the transport of firewood, fodder and agricultural produce. In addition, and importantly, they also still provide a means of emergency transport when no vehicles are available or when weather conditions have made roads impassable to motorised transport.

Donkey husbandry and use

The vast majority of the donkeys employed in the communities are bought at one to three years old at nearby livestock markets which are, in general, held weekly. Prices range from $US 30 to $US 50 and, whilst most animals are sold untrained, premiums are paid for trained animals. Working life is reported to vary between five and ten years, which suggest that life span varies from six to 13 years. If a jenny produces a foal, this animal is normally sold unless household needs dictate otherwise.
The management of work animals is reported to be the responsibility of the men. Animals are trained over a period of one week to a month, during which time they are usually worked with a more experienced animal. Feeding is not considered to be a problem during the wet season (November to March). They are mainly grazed on natural pasture from communal or fallow land and during the drier periods of the year, they also receive cereal straw or maize or bean stover which is stored in sheaves or heaps near to the homestead (Figure 1). No supplementary feeds are bought for the animals.

Although health problems are not common, cases of angina and colic do occur occasionally, especially during the change from the drier to the wetter periods. Foot rot and excessive hoof growth are also reported, but, in concurrence with the other health problems mentioned, these could be avoided through an improvement in management practice. Veterinary care, as is the case for all other livestock, is virtually non-existent due to a general lack of knowledge of medications and treatments, difficult access to sources and high costs. The few traditional treatments that are practised within the communities are reported to have variable success rates. Housing is not provided to the animals and overnight they are normally tied-up outside the house to a stake or a tree.

Pack saddles are not commonly used in the area. In general only a blanket or a fertiliser bag is thrown over the animal's back for protection before the load is applied. Loads, which are carried over the back rather than over the withers, either hang loose or are tied up with a rope under the animal's belly. The animals are used, on occasion, to transport firewood to the house or manure from the livestock corrals to the fields. Another common use is the transport of alfalfa or other fodder to the farm to feed the dairy animals and oxen. On fields which cannot be reached by motorised transport, donkeys are often employed to transport agricultural inputs and harvested materials the short distance from the field to the road (Figure 2).

Donkeys; options and challenges for the future

It is apparent that major changes have occurred in the utilisation of donkeys in the Andean region of Bolivia and given the current pace of developments in the region, this trend is likely to continue. Although the use of appropriate pack-saddles and the placement of loads over the withers could have some impact, there are relatively few realistic options to improve the animals' pack-capacity. In the end, an animal is only able to carry so much. Nevertheless, several low-cost possibilities and options are thought to exist to optimise the use of this currently chronically under-utilised animal resource.

Cultivation

Apart from the primary cultivation which is done with oxen, all other field operations are carried out by hand. There are, however, various possibilities to employ donkeys in low-draft tasks such as for example inter-row weeding. Such activities have been successfully carried out by donkeys in other farming systems (e.g. Betker, 1993; Embhardt, 1994) and their introduction warrants serious consideration in the current context. Unfortunately, appropriate implements for these types of operations are not available in Bolivia at present. However, with the continued increase in the establishment of small blacksmith workshops in many communities and the collaboration of more traditional farm-machinery manufacturers, there are distinct possibilities to adapt, manufacture and evaluate low-cost implements that have proved successful in other areas. One of the main stumbling blocks, though, is the established cultural prejudice against the employment of donkeys for any other kind of activity than the transport of goods. Nevertheless, attitudes are changing and in two of the communities in which the PRA was carried out, donkeys and horses are already occasionally employed for the threshing of cereals and broad-beans.

Soil and water conservation

In the semiarid conditions of Cochabamba Department, the conservation of water is of vital interest to farmers. Coupled with the fact that steep, fragile hillsides are cultivated for annual crops, soil conservation is also a priority concern with farmers. Reduced tillage techniques that are relevant answers to these concerns include contour and strip tillage to promote rain-water infiltration and reduce the risk of soil loss through water and wind erosion. Equipment developed for these techniques has generally been of high draft requirement, but efforts have been made to design equipment suitable for low draft animals such as donkeys (Sims *et al.*, 1996) which merit adaptation and evaluation under the conditions of the Bolivian valleys.

Carts

The improvement in the road infrastructure has also opened up possibilities for the introduction of animal-drawn carts in the region. The use of carts would not only significantly increase the transport capacity and efficiency of donkeys, but it could also

provide a, potentially, low cost alternative to motorised transport. Whereas the introduction of animal-drawn carts has frequently proved to be prohibitively expensive, recent publications suggest that a variety of good low-cost alternatives are feasible. The introduction of animal-drawn carts could also benefit greatly from the technology and experience of the Mennonite communities which have been using horse-drawn carts for centuries and are settled in the Bolivian lowlands. Any design adopted, however, will need adaptation to the specific conditions of the region and particular attention will have to be paid to the braking systems which are of the utmost importance in hilly environments (Chadborn, 1991; Dennis and Anderson, 1994).

Harvest and post-harvest equipment

During the study, farmers expressed a desire for a reduction in the drudgery of harvest and post-harvest operations such as the selection of potatoes and the threshing or milling of cereal crops. The machines for these types of operations currently available on the Bolivian market are in many cases either too expensive or inappropriate. There are various examples of these types of implements that have been specifically designed or adapted to be driven by animal-energy (e.g. Starkey *et al.*, 1989; Dippon, 1993). Most of these constructions and machines, however, are rather intricate and relatively expensive and although their investigation may warrant attention in the future it is not perceived to be a immediate priority, nor is their adoption in the current climate thought likely.

Proposed follow-up

Whereas all the above mentioned options warrant serious investigation, this does not imply that improvements in the general husbandry and management of donkeys *per se* should receive a lower priority. It is expected though, that the incentive for these type of improvements will be a direct result of the wider employment and integration of donkeys into the agricultural process. A follow-up proposal, which addresses the identified opportunities as well as general husbandry constraints in an integrated manner, based on the results of the PRAs together with a confirmatory workshop, attended by community representatives, intermediate users and scientists, has been formulated and submitted for funding. The project proposes, using participatory methodologies, to select and evaluate appropriate technologies and aims to improve the efficiency of use and diversify the utilisation of working animals by small-holder hillside farmers. The project will develop improved animal management strategies through activities in animal health, fodder production and conservation and utilisation and housing. It will also develop improved equipment for use by working animals and this will address the wider problem of degradation of natural resources, principally land, soil and water, through unsuitable agricultural practices. These activities, which will have a significant impact on the utilisation and management of donkeys, are proposed to commence by April 1997 and to be conducted over a three year period.

Acknowledgements

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Table 1: Animal population (1000s) for selected species in Bolivia

	1979/81	*1992*	*1993*	*1994*
Cattle	4570	5779	5794	6012
Donkeys	680	631[1]	631[1]	636[1]
Horses	330	322	322	324
Mules	86	81[1]	81[1]	81[1]
Llamas	na	1516[2]	1552[2]	na

[1] FAO Estimates
[2] SNAG, Departamento de Estadísticas Sectoriales 1994
Source: FAO, 1995

Figure COMUNIDAD BOQUERON K'ASA. MOBILITY DIAGRAM