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The Valles Altos
in Bolivia**

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Development Alternatives, Inc.
Tropical Research and Development, Inc.

in association with:

Earth Satellite Corporation
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**ENVIRONMENTAL ASSESSMENT:
THE VALLES ALTOS PROJECT IN BOLIVIA**

by

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Prepared for the U.S. Agency for International Development
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BACKGROUND

The Need for an Environmental Assessment

AID/Bolivia, in consultation with the AID Andean Regional Environmental Adviser (REMS/SA) and the Chief Environmental Officer for the Latin American and Caribbean Bureau of AID, determined that the planned Chapare Regional Development Project Amendment for the Valles Altos region in the department of Cochabamba, Bolivia, required that an environmental assessment (EA) be approved before implementation of the amended project could begin. The planned project components in agriculture, forestry, and irrigation could have significant adverse environmental impacts in the region. In accordance with Section 216.3 of the AID Environmental Procedures, which reflects requirements of the Foreign Assistance Act, such potential impacts require the preparation of an EA.

The need for an EA was determined by the fragile balance of the natural and agricultural ecosystems in this arid zone near Cochabamba and by the degraded nature of parts of the region. The area shows extensive over-grazing, steep and often eroded slopes and severely salinized soils in some parts. Limited rainfall of 300 to 600 mm per year and characterized by thunderstorms with associated flash floods occurs between November and March. Water in some streams is apparently naturally salinized by flowing through strata rich in sodium or other mineral salts.

The low forests existing in many non-agricultural areas, particularly on steep slopes, are primarily of xerophytic shrubs and trees. These are often overgrazed by sheep and other livestock, with consequent limited reproduction of the vegetation, loss of biological diversity, and erosion from loss of vegetative cover. There are only a few areas of relatively intact natural vegetation; they include some potentially rare or endangered species of plants, and often represent the limited remaining habitats of endemic or rare animals, including migratory birds. These environmental conditions require that any development activities be undertaken with great care, both to avoid irretrievable loss of the existing biotic and abiotic resource base, and to restore degraded systems for sustainable utilization of their resources.

The Chapare Regional Development Project (CRDP)

Current Status

AID/Bolivia funded a comprehensive evaluation of the amendment to the CRDP in September 1986 to re-examine the strategy for substitution of coca with other crops and activities in support of coca control, and to resolve issues encountered in project implementation. The evaluation's findings were discussed with Government of Bolivia (GOB) officials during a two-day workshop in November 1986, to assure that remaining project funds would be used in the most effective way possible to support United States Government (USG) coca-control objectives.

As a result of the workshop, it was decided to amend the project paper and to expand the geographical focus of project activities to the Valles Altos region of the department of Cochabamba. This will be done to help encourage a large number of Chapare farmers and laborers who, having migrated to the Chapare from the Valles Altos in large numbers during the last several years, are now returning to their places of origin. It is hoped that these farmers will forsake their involvement in coca production and processing as GOB control activities proceed. The effort will be a large-scale test of a model of integrated investments to improve the social and economic development potential of selected areas of origin, to accelerate return migration, and to increase retention of the existing populations. If successful, the funding of a much larger effort to expand the impact of these activities to more areas will be considered.

Under the amendment, presently obligated funds will be reprogrammed. The life-of-project amount will not increase. The funds released from ongoing activities no longer deemed high priority will be used to expand the focus of existing CRDP activities to the associated high valleys above Cochabamba, and to finance infrastructure support activities in the associated valleys. At the same time, agricultural research and extension will continue in the Chapare subregion to supply viable alternatives for those farmers who stay there and eradicate their coca. The project will also support several agroindustrial subprojects in the Chapare subregion. Resources from other AID-financed projects, including Private Agricultural Organizations, Market Town Capital Formation, Housing Insurance Guarantee, and

Emergency Agricultural Credit reflows will be managed by the PL-480 office of the GOB and AID.

Choice of Valles Altos Region for Amended CRDP Activities

The choice of the districts of Campero and Mizque in the southern planning district of the department of Cochabamba was made by the Program for Alternative Development in Cochabamba (PADC), the primary implementing GOB agency for the CRDP. Resources will be focused on that area of the Valles Altos where conditions of underdevelopment are most pronounced and which has historically seen heavy emigration to the Chapare. The two districts of Campero and Mizque (with their capitals Aiquile and Mizque) are the most isolated from the departmental capital, Cochabamba, and its urban services and markets. It is assumed that improvements in quality of life through project investments in agriculture, transportation, community infrastructure, reforestation, and protection or restoration of agricultural ecosystems will have a measurable effect on migration. If satisfactory results are obtained in this initial phase, then the effort can be broadened to include other districts in the Valles Altos.

Affected Environment

In general, the Valles Altos are characterized as semi-arid with relatively fertile soils suitable for rainfed or irrigated agriculture. Water is a primary limiting factor in all activities in the region, with rainfall of 300 to 600 mm occurring primarily from November to March, often as thunderstorms with associated flash floods. Altitudes range from 2,710 meters above sea level at Tarata, to 2,740 meters at Arani, resulting in the name *valles altos* (high valleys) in relation to Cochabamba, which is situated at 2,560 meters. The existing vegetation includes primarily dry grassland or low shrub steppe, and xerophytic communities of low shrubs or small trees. The region has long been settled and cultivated, and few natural ecosystems remain intact.

Project Components

Introduction

The original project agreement of August 12, 1983 included three components: agriculture and forestry production; agroindustrial development and marketing; and institutional development. This package of assistance has been modified and is described in the following subsections. Environmental education, and the protection or restoration of fragile or degraded natural or agricultural systems will be included in all of these components.

Agriculture and Forestry Production

The research and extension activities envisioned in the current agreement under this component will continue to be carried out in the Chapare region. To these will be added activities in the associated high valleys, including natural resource management, applied research and extension of technical packages for productivity and production improvement, and agricultural production credit.

Rural Industry and Marketing

This component will continue to fund specified agroindustrial and complementary marketing activities in the Chapare, and will be expanded to fund similar activities in the Valles Altos, especially those related to preinvestment studies and rural industry credit.

Productive, Transport, and Community Infrastructure

A series of activities will be funded to improve and, where necessary, to construct productive, transport, and community infrastructure. In the area of productive infrastructure, the project will undertake rehabilitation of existing irrigation systems; studies of hydrological and other factors for the design of new irrigation works; implementation of new irrigation systems; and design and extension of improved on-farm water management practices. These will be implemented through various arrangements to be made by the PADC. The project will also fund

the implementation of improved transport infrastructure. Upon termination of the Rural Roads II Project, the remainder of its undisbursed funds will be transferred to the project to support this activity. The final part of this component will be the funding of community infrastructure. Potable water, rural sanitation, and improvement of existing electrification will be the specific activities in the category. The PADC will be provided long- and short-term technical assistance and training for the implementation of this component.

Project Investment Fund

The Project Investment Fund will be used to fund initiatives of implementing agencies with proven track records in promoting development in the Valles Altos, and to finance the coordination of those initiatives within the framework of a regional development plan intended to reduce migratory pressures. The PADC will receive proposals for activities from organizations, analyze them for their technical, social, environmental and economic feasibility, and then either approve them for funding, indicate the proposals that could be strengthened by more work, or reject them. A scale of activity size will be established so that projects with limited budgets can be approved with less intensive review than those of a larger size. If approved, agreements that indicate specific and measurable outputs, and that assign to the PADC a comprehensive role in monitoring, evaluating, and auditing of the implementing agencies' activities will be developed and signed. This fund will also be used to finance agreements between the PADC and institutions that provide technical and analytical support to implementing agencies.

Planning and Analysis for Implementation

This component will finance the studies necessary to plan and design the above-mentioned activities. These activities will be focused in geographic regions where there is potential for social and economic development, and to which former Chapare coca farmers are expected to return. The analyses to be undertaken will be in the areas of natural resource potential and constraints, agronomy, animal husbandry, hydrology, civil engineering, institutional capacity, marketing, and financial viability in specific subregions.

Institutional Development

The administrative structure will remain basically unchanged in that the PADC will remain as the central coordinating entity for project implementation. Institutional support will continue to be provided to the PADC and to the Bolivian Agricultural Technology Institute for the Chapare (IBTA/Chapare). There will be a number of new, mostly private, organizations involved in implementation whose work will be structured through agreements. They will carry out specific subprojects and will also receive limited support for institutional strengthening. IBTA/Chapare will continue to be the principal implementing agency for Chapare subregional activities in research, plant material production, and extension.

ENVIRONMENTAL ASSESSMENT

Alternatives to Project Implementation

The alternative to this development project would be no action at all. Because many of the components of the region's ecosystems are being rapidly degraded due to factors mentioned above, this alternative would lead to even further environmental degradation. Implementation of the proposed amended project, carried out with protection or restoration of these systems as a constant goal, will have a positive environmental impact. It is recommended that the design of the Chapare Regional Development Project Amendment and this environmental assessment be approved.

Project Design

The amended project and the present environmental assessment include the environmental and social conditions and constraints to development as integral parts of the design process. The common error of first designing a project and then analyzing its potential environmental and social impacts has thus been avoided. The project design team included an anthropologist, an ecologist, a forester, and specialists in irrigation and agricultural systems. This team was supported by preliminary reports, prepared specifically for this study, on social communications, the role of women in local affairs, institutional capabilities, floristic and faunistic data for potential conservation needs, and geography and land-use assessments of the

region. It also contained a bibliography of development-related activities. Drawing upon a preliminary assessment and field verification of the actual environmental conditions prevailing in the associated high valleys, the environmental strategy built into this project design emphasizes the sustainability of the development effort and minimizes adverse environmental impacts of project activities.

The inclusion of environmental analyses in the design stage of this development project should ensure not only that the development activities will be sustainable, but also that the resource bases upon which they depend will remain productive. Moreover, it must be recognized that traditional resource utilization practices, such as overgrazing and deforestation, often produce as much environmental degradation as new development activities. Therefore, this development project is designed to produce minimal environmental disturbance and at the same time, to improve the productivity of traditional resource exploitation methods and restore the productive capacity of the resource base.

Such an approach in project design is both advisable and effective in producing a better development effort. It allows for a sustainable impact upon the population involved and it preserves future development options. Given the institutional and time constraints within which the project activities will be carried out, the environmental strategy also focuses on producing tangible results within a reasonable time. In addition, it overcomes some of the limitations involved in executing resource management activities in the region, and it gives a basis for larger-scale interventions in the field of resource management and environmental protection.

Environmental Impacts

Insignificant Impacts

Planned or proposed project activities will have no significant impact, or no impact at all, on the following natural ecosystem components and human/social systems:

- Air quality: no changes are envisaged;
- Fish populations: negligible in seasonal streams;
- Timber: insignificant amounts in the xerophytic forests;
- Social structure: project activities are oriented to improving existing organizations;
- Tourism and recreation: present levels are insignificant;
- Archaeological, historical, and cultural resources: none of any significance are presently known in the region; and
- Visual resources: insignificant changes to existing systems.

Positive Impacts

Positive impacts are foreseen from project activities in the following components:

- Biological diversity, wildlife, xerophytic tropical forests, and other natural vegetation: protection and conservation, or restoration of communities, habitats, and rare or endangered species;
- Soils: restoration of degraded soils and protection from erosion;
- Water: protection of watersheds and control of water quality and quantity; and
- Land use: studies designed to determine land-use capacity and actual land use will be used to ameliorate misuse.

Areas of Controversy and Concern

Specific areas of controversy and concern regarding any potentially negative impact on the environmental resources of the project area include the following:

- The use of pesticides in yet-to-be identified agricultural and forestry activities. When project-related activities are identified, an amended EA based on a program of Integrated Pest Management (IPM) will be prepared to address all pest management practices being proposed.
- Some planned forestry activities involving the use of exotic species, primarily pine and eucalyptus. Species of both these genera are poor choices for

erosion control or land and soil rehabilitation. Sites chosen for planting these species must be reviewed by experts in ecology and soil conservation to assure that the tree species used are appropriate for the goals of the plantation activities in watershed protection.

- The rehabilitation of the Rodeo to Mizque road segment. This activity should be subjected to a traffic and marketing study to determine actual need, and should take into consideration the options of no action, of limited rehabilitation, and of improved maintenance of the existing road. This activity will require a specific environmental assessment. All other road rehabilitation or reconstruction presently planned should be included in a general assessment of road works.

Environmental Analyses and Reviews

Introduction

Due to the lack of significant environmental, institutional, or social baseline data necessary for planning, many specific subproject activities with potentially significant environmental impacts such as irrigation, pesticides, and protection of biological diversity, are treated only in a general way in this EA.

Amendments to this EA will be required for any future project activities which may have adverse environmental effects. These will include most new subprojects proposed in agriculture, irrigation, or pesticide-related activities. Multiple subprojects involving similar implementation activities, such as related irrigation subprojects within a general watershed, can be included within a single assessment. The need for amended environmental assessments must be determined by consultation with the AID/Bolivia Environmental Officer, or the Andean Regional Environmental Adviser (REMS/SA), and the AID/LAC Bureau Environmental Officer, with approval from the latter required before implementation of any activities. These requirements must be stated in the bilateral agreement between the GOB and the USG, as either covenants or conditions precedent.

The requirements for delayed Environmental Review are detail in the AID Environmental Procedures (22 CFR Part 216) in Section 216.3(a)(7), part of which follows:

7) Environmental Review After Authorization of Financing

- (i) Environmental review may be performed after authorization of a project, program or activity only with respect to subprojects or significant aspects of the project, program or activity that are unidentified at the time of authorization. Environmental review shall be completed prior to authorization for all subprojects and aspects of a project, program or activity that are identified.
- (ii) Environmental review should occur at the earliest time in design or implementation at which a meaningful review can be undertaken, but in no event later than when previously unidentified subprojects or aspects of projects, programs or activities are identified and planned. . . .

Pesticides Assessments

All uses, purchases, or recommendations of pesticides will require an EA amendment, and the specific pesticide uses or recommendations must be approved by the AID/LAC Bureau Environmental Officer as stated in the AID Environmental Regulations and the Foreign Assistance Act. This requirement must be included as a covenant in the bilateral agreement for the amended project paper between the USC and the GOB. The use of existing Bolivian organizations, e.g., PROCIPLA in Cochabamba, or assistance from AID projects in integrated pest management, is designed to reduce the environmental impacts of any pesticide activities that may be planned in the future.

Project Evaluation

The Andean Regional Environmental Adviser (REMS/SA), and other environmental specialist(s) designated by the AID/LAC Bureau Environmental Officer, will participate in periodic technical and field evaluations of the project to determine continued compliance with the conditions and recommendations of this EA and subsequent amendments.

Project Environmental Strategy

Introduction

The environmental strategy built into this development project is, in essence, the present environmental assessment. Its integration into the design should assure the proper implementation of environmental safeguards in developmental activities such as irrigation, rural infrastructure, and resource utilization. For strategic and practical purposes, the implementation of the environmental/resource management strategy involves immediate activities, pre-investment studies, and technical assistance.

Essential preliminary activities are the relatively detailed land capability assessment and the hydrological studies needed before investments are made in irrigation systems. The land capability assessment will identify areas of highest agricultural potential; agricultural areas requiring rehabilitation; areas suitable for plantation or natural forestry production; and natural areas appropriate for protection or recuperation through management, including passive management where not threatened or significantly degraded. The hydrological studies will include establishment of stream gauging, water and sediment sampling, and meteorological measurement networks in order to determine the amount of surface water available for irrigation, power generation, and potable water supplies. Estimates of groundwater yields will be made.

A number of important issues have been treated within the project paper. Their relevance within the project design is a function of their interrelationship with improved agricultural productivity, sustainable development impact, and the conservation of the resource base upon which the development effort depends. Emphasis has been placed upon:

- Sustainable land use practices;
- Water resources management;
- Ecologically appropriate farming and livestock production systems;

- Reclamation of eroded land and regeneration of degraded forests; and
- Control and reduction of deterioration of agricultural and grazing lands, and consequent effects upon migratory pressures.

Major Components

The environmental strategy consists of the following major components:

- Early collection of baseline data on those resources and systems that are essential to planning, or that may be altered by project activities. Examples of these data types are water quality, flow rates, and sediment loads for potable water and irrigation activities; land-use capability assessments for potential agricultural and natural resources protection activities; floristic, faunistic, and habitat distribution data for activities required to protect or restore endangered or critical ecosystem components.
- Continuous or periodic monitoring of water, soils, and biotic elements that may be adversely affected by project activities, or changes that may adversely affect sustainable continuation of project activities. For example, erosion and consequent increased sediment loads and altered water flows will adversely affect planned irrigation projects, and will require changes in subproject designs. Irrigation with inadequate drainage can cause irreversible salinization of agriculturally productive soils. Changes in livestock management systems may cause excessive grazing on steep slopes, resulting in increased erosion due to loss of vegetative cover.
- Environmental education of local residents. This will concern the need for protection and careful utilization of scarce water resources in this arid zone, and the basic concepts of sustainable utilization of renewable resources to protect the natural and agricultural ecosystems upon which the social and economic livelihoods of the local residents depend. Included also will be community participation in project activities and specific environmental education efforts through rural communications media.
- Reforestation of upland areas for work production, soil conservation, and water retention. This will include both plantations of native species and exclosures where feasible, to allow for the regeneration of native biotic communities and to protect and increase diversity in these xerophytic forests.
- Institutional support to develop the human resource base. This includes those staff specifically trained and qualified to plan and execute sustainable resource management activities in the future. An understanding of the environmental and social constraints essential to such development efforts will be essential.

- Support to the implementation of rural infrastructure activities such as roads, irrigation systems, hydroelectric power development, and riverine protection works with goals of assuring sustained utilization and minimizing environmental impacts.
- Establishment of management plans for the protection of ecosystems, communities, and species that are endangered or threatened.

The institutions involved in the execution of these activities will be financed and coordinated by the PADC.

Immediate Activities

The Vacas Reforestation Project

This project involves soil conservation efforts and the establishment of tree plots on private and communal lands for production of timber and lumber. At the end of the third year this project will have established 540 hectares of forest plantation, with 60 percent in pine, 30 percent in eucalyptus, and 10 percent in native trees. The reforestation activities will take place in the Vacas region, which is within the upper reaches of the Tucma-Uyuchama watersheds. Through the production of timber, lumber and fuelwood, the project is expected to diversify the sources of income of the participating farmers while bringing into production marginal or otherwise unproductive lands. Soil conservation and water retention objectives will also be achieved. The cost of the project amounts to \$445,000 over three years.

A project design is being completed and, upon approval of the design and its associated EA for this and related forestry activities planned in the project, will be executed by the reforestation unit of the Regional Development Corporation of Cochabamba, supported by Swiss Technical Cooperation (COTESU/CORDECO), under the supervision of the PADC.

This activity will involve the use of exotic species -- primarily pine and eucalyptus. Eucalyptus has grown in Bolivia for more than 150 years; many of the pine species for at least several decades. Species of both these genera are poor choices for erosion control or land rehabilitation. Sites chosen for planting these

species must be reviewed by competent experts in ecology and soil conservation to ensure that the tree species used are appropriate for the goals of the reforestation activities in watershed protection, and are not used for economic or multiple-use goals.

Institutional Support to ETSFOR

This support aims at strengthening the capacity of the Escuela Tecnica Superior Forestal in Cochabamba (ETSFOR) to train mid-level technicians in watershed management, agroforestry, range management, and highland forest management techniques. The component will specifically provide financing for short- and long-term specialized training abroad (in Costa Rica, Brazil, Spain, and Chile) for students and faculty. It will also fund a two-year teaching assignment and a program in agroforestry systems. This institutional support activity is expected to double the number of technicians graduating from the school. The focus of the training will be on the management of highland resources. Disbursements will be made upon presentation of specific proposals within the framework established by an arrangement with the PADC. The institutional support activity will cost \$120,000 over three years. It will not have direct or adverse environmental impacts but, on the contrary, should lead to long-term protection and recuperation of ecosystems in the region.

Establishment of Tree Nurseries

This activity will supply 50,000 seedlings per year for small tree plantations in the arid zone of Mizque and Aiquile, in order to provide construction timber, fuelwood, and fodder, and to supplement the incomes of participating farmers. The establishment of these tree nurseries will cost approximately \$40,000. Emphasis will be placed on fast-growing trees that supply a variety of locally useful products. Environmental assessment of this activity will be covered in the planned EA of the Vacas and associated forestry activities. Tree nurseries are not expected to have a significant impact due to the small areas involved. Pesticide use must be explicitly addressed in the forestry EA amendment and must be included in the IPM program.

Road Rehabilitation

This activity involves the rehabilitation of a 46 km segment of road through the Valles Altos plain from Angostura to Arani, and another 40 km segment connecting Mizque and Aiquile. Neither will have a significant environmental impact if precautions are taken to adequately space and design drainages along their paths. A 17 km stretch between Angostura and Tarata will be paved using traditional cobblestone technology.

Two additional road segments affecting more fragile mountain environments are also proposed for rehabilitation: Arani to Rodeo (27 km), and Rodeo to Mizque (79 km). While the first segment could be rehabilitated by taking the appropriate protection measures and by applying adequate design criteria, the segment Rodeo to Mizque should be carefully studied before investing in its rehabilitation. Specifically, an economic analysis should be performed of traffic and commercialization patterns once the road segment Mizque to Aiquile is completed, as well as of the costs of rehabilitating and maintaining this mountain road. In addition, and as a result of the in-depth biological diversity study performed in this region, an EA should also be carried out with consequent changes in road design if needed.

Finally, two short road segments, Tarata to Pampa de Churigua (8 km), and Racaypamapa to Laguna (16 km), should not require major investments nor should it affect the natural environment significantly. However, design criteria that protect the downslope side of the road and provide revegetation of the road cuts should be strictly applied.

Pre-Investment Studies for Projected Activities

Introduction

EA amendments will be required for specific subprojects and other new activities (or groups of subprojects or related activities), if these activities involve significant alteration of ecosystem components or if they have potentially adverse environmental impacts. Examples of such activities are:

- Construction of physical structures to control erosion for protection of endangered habitats, or for other erosion control purposes;
- Introduction of exotic plant or animal species as part of livestock and forestry management plans; and
- Significant alteration of existing irrigation systems, or introduction of new irrigation structures, particularly those resulting in changes in water flow or quality.

Land-Use Capability and Watershed Management Plans

This activity is designed to guide development activities so as to minimize environmental impacts that could result from inappropriate use of resources. These studies will involve three major watersheds, with direct implications for actual and future irrigation systems. The actual land use, potential land use, and ground cover studies will include approximately 80,000 hectares and will enable the elaboration of specific watershed management plans. CUMAT (Capacidad de Uso Mayor de la Tierra), a qualified NGO in La Paz specializing in land-use capability assessments, will carry out the studies and will also execute the initial steps of the implementation strategy. The studies will be completed within the first year of the project and the management plans will be ready for execution at the beginning of the second year. The cost of this series of pre-investment studies is estimated to be \$300,000.

Biological Diversity Studies and Protected Area Management

A number of areas of exceptional biological diversity have been identified within the project region. Detailed faunistic, floristic, and habitat inventories are required for the development of appropriate management plans. These studies are designed to guide the selection of sites to achieve the maximum possible protection of diverse natural resources, either through passive or active protection. These studies will be carried out by the CDC (Centro de Datos para la Conservacion in La Paz) under subcontract with CUMAT, and will be based on the preliminary studies by the CDC which are included in the project design. The studies will also produce specific environmental education packages as part of the management plans for protected areas. Positive environmental impacts should result from the implementation of these

studies. The study will cost approximately \$40,000 and will take approximately six months.

Inventory and Management of Xerophytic Forest Resources

Extensive areas of xerophytic forest are found within the project region. They represent a valuable resource which could support local forest industries such as the production of musical instruments and furniture, as well as serve as a source of fuelwood, fodder, and fruits. The sustained productivity of these areas is being threatened by extensive grazing activities. This study should result in specific management plans for the dry forest resources of the region. It is designed to restore the sustainable productivity of natural forest remnants in the project area. Environmental impacts of these activities should be positive. This study will be carried out by CUMAT at an approximate cost of \$60,000.

Research and Extension on Grazing Practices

The resource base of the region is threatened by extensive grazing practices by goats, sheep, and cattle. More intensive management systems need to be developed to conserve the grazing and forest resources of the region. This research and extension project aims to develop appropriate management packages by means of experiments involving the improvement of the forage sources, the rationalization of the grazing strategy, and the improvement of animal breeds. This activity is designed to reduce the ecological, erosional, and economic impacts of overgrazing. The research will be carried out by the research unit of COTESU/CORDECO at a cost of approximately \$150,000 over three years.

Irrigation Studies

A number of pre-investment studies of small to medium irrigation systems will also be performed. Most of these systems will derive the water from catchment areas proposed for study and management in a later section of this report. As part of the development of these irrigation systems, it is recommended that sedimentation ponds be established to determine sediment volume and to monitor water quality. CUMAT and the technical department of the PADC will implement and oversee these activities. Most irrigation systems will involve only the rehabilitation of existing

systems with increased emphasis on proper water management and watershed protection. The greatest potential impacts of irrigation activities are the increased use of pesticides and fertilizers, and the negative effects of reduced water quality and quantity on downstream ecosystems. It is expected that these rehabilitation works will not have significant environmental impacts. Once proposed actions are clearly identified, an amended EA will be prepared.

Potable Water Systems

The need for improvement or construction of potable water systems in local communities will be studied. This will require careful consideration of water quality, and particularly of pesticides and other potential pollutants that may be present in some systems. Baseline data on water quality in the region will be essential before specific feasibility studies can begin, although most of these data will be part of the information gathered for irrigation pre-investment studies. Planned activities in irrigation and agriculture, particularly involving application of pesticides and fertilizers, must be carefully coordinated to avoid contamination or reduction in supply to local and downstream water users.

Agricultural Development and Integrated Pest Management

Most of the agricultural activities resulting from the implementation of this project are still not specifically defined. The execution of these activities is subject to pre-feasibility studies and conditioned to receive technical assistance from specialized research and extension institutions such as the Pairomani Institute, the Agronomy Department of the University of Cochabamba (UMSS), and the Potato Seed Research Institute (SEPA). Moreover, it is also expected that implementation of agricultural development activities will be monitored by periodic assistance from an IPM team from PROCIPLA in Cochabamba and/or through AID/W.

Amendments to this EA will be required for any pesticide-related activities planned in the project, including any purchase, use, or recommendations of specific pesticides. These activities should all be carried out as part of an IPM program. Design of such a program will constitute the basis for an amended EA. Under close supervision of an agricultural systems adviser within the PADC, and with prior

approval of the AID/LAC Chief Environmental Officer for all specific pesticides, these activities in IPM are not expected to have significant environmental impacts.

Technical Assistance and Training

Forest/Watershed Management Specialist

The PADC requires the assistance of a forest/watershed management specialist who will coordinate the activities of this institution and supervise forestry-related components of the projects being executed by other institutions such as CUMAT, COTESU/CORDECO, and the CDC. This assistance should cover the duration of the project and involve a forest/watershed management specialist, preferably trained or resident in Bolivia, with experience in planning and coordinating activities in a wide range of subjects within an interdisciplinary context. The cost of this technical assistance is estimated to be \$60,000. Given the experience and capability of the USDA Forest Service in matters relating to forest management and environmental protection, USAID/Bolivia should consider utilizing the USFS via the AID/W Forestry Support Program to meet, or advise on, overall project technical assistance needs in forestry.

Ecologist/Hydrologist

Long-term technical assistance on environmental monitoring and resource management, preferably an ecologist with particular expertise in hydrology and water quality, is recommended during the course of this project. This assistance will be essential in planning new subprojects and other activities, and in guiding preparation of required amended environmental assessments for all new activities not specifically covered in this EA. The ecologist will be required to collect, analyze, and interpret the required baseline and pre-investment studies environmental data, and to carry out all required continuous monitoring of environmental variables which may be affected by project activities during the life of the project. This technical assistance is also needed to orient the PADC and the executing institutions in the necessity of environmental concepts and framework built into the project design for sustainable development, and in the development of environmental education programs.

This position requires prior experience in US- or AID-related EAs. Starting immediately so as to include the present rainy season, the specialist -- in coordination with other project personnel -- will establish the methodologies for collecting and interpreting the baseline data on soils, water, and biotic factors in potential project areas, and in the watersheds above and below these areas, in conformity with the requirements of the Foreign Assistance Act and AID Regulation 22 CFR Part 216 and subsequent applicable amendments. The specialist will use the baseline data and, in consultation with other project personnel, will determine and establish methodologies and protocols for the environmental parameters that will require continuous monitoring during the life of the project.

These determinations will be based on demonstrable need and on applicability of the resultant data for the project, and will be done in the simplest and most economical manner so that they can be continued, if financial constraints permit, after the project ends. Whenever possible, laboratory analyses of samples should use local facilities, in order to verify the reliability of the analyses of duplicate samples in laboratories approved by the US Environmental Protection Agency. This specialist will establish regular communications with the Regional Environmental Adviser and with the LAC Bureau Environmental Officer.

ENVIRONMENTAL ASSESSMENT RECOMMENDATIONS

Introduction

It is recommended that the Valles Altos project be approved. The environmental assessment attached to the project paper amendment should provide the basis for the approval of the project by the Bureau Environmental Officer. Any subprojects or other project activities not specifically assessed in this EA will require amended EAs before funding or implementation.

Specific Environmental Actions Required

These include the following:

- The rehabilitation of the Rodeo to Mizque road segment should be subjected to a traffic/marketing study to determine actual need, considering the options of no action, of limited rehabilitation, or of improved maintenance of the existing road. This activity will require a specific EA. All other road rehabilitation or reconstruction presently planned should be included in a general assessment of road works.
- Technical assistance should be provided to the PADC in forest and watershed resource management.
- Technical assistance in environmental monitoring and resource management, preferably by an ecologist with particular expertise in hydrology and water quality, should be provided to the PADC.
- Technical assistance in integrated pest management called for by the agricultural development component of the project must be assured during the planning and execution of project activities.
- Adequate design and construction standards must be applied to the rehabilitation of the road segments Angostura to Arani, Mizque to Aiquile, and Arani to Rodeo to be executed under the Rural Roads II project funds.
- Prior to planting exotic species, such as pines and eucalyptus, past performance on similar sites must be reviewed to assure that anticipated benefits in erosion control and other environmental parameters will be forthcoming, and that these species will not adversely affect existing water supplies through excessive net evapotranspiration. Wherever possible, locally native species should be used to assist in the preservation of local biota and habitats.

Mitigations to Ensure Sustainability

A number of measures need to be taken for the proposed activities to achieve their objectives and sustain the development effect over and beyond the duration of the project itself. They include the following:

- Activities should be planned and implemented only when the participating institutions have the proven capacity to carry out the activity both in terms of personnel and organizational structure, and when they have demonstrated an awareness of the fragile nature of the region's natural and agricultural ecosystems and the environmental constraints to development activities in the region. Short-term training and workshops may be appropriate in these areas for some institutions.

- Field research activities should be coordinated with the local population whose land could be used for demonstration areas, or whose economic activities could benefit from the research results. Because research activities are evaluated from results beyond the experiment plots, the participation of local farmers in the research activities is essential. The potential benefits of these activities need to be properly explained to the entire community, and related to the general environmental constraints that affect productivity and income.
- The environmental monitoring and resource management adviser, part of the technical advisory team to the PADC, should monitor all activities implemented during the course of the project. Emphasis should be placed upon environmental impacts -- both positive and negative -- of each activity and short reports detailing these impacts should be prepared. These reports should be submitted to the environmental officer (AID/Bolivia) and forwarded to the Regional Environmental Adviser (AID/Peru). This will be in addition to guiding preparation of required amended environmental assessments for all new activities not specifically covered in this EA. It is hoped that a qualified local counterpart can take over these responsibilities after a year of joint work with the adviser. It is essential that the project contact local agencies who may be able to utilize continuing data collection for their own needs after termination of the project.

Community Participation and Rural Communications

In order to be effective and achieve long-term benefits, the resource management strategy proposed for this project must involve not only experienced institutions but also, and most especially, the rural population. Their participation is essential in carrying out, maintaining, and expanding the benefits of the proposed activities.

Community and farmer organizations should be immediately contacted, either directly or through the executing institution, and their participation in planning and design of any activity encouraged. Of course, their participation will be required in the execution of many of the activities, but that will be assured only if they have also contributed during the early stages of the proposed activities, and if they understand the fragile nature of the Valles Altos ecosystems upon which these potentially renewable resources depend.

Mass media and communication networks such as radio, newspapers, and pamphlets, can play a critical role in the dissemination of appropriate watershed and livestock management techniques, as well as other activities with potentially adverse

environmental effects. The institutions involved in rural communications -- Radio Esperanza, Cono Sur, and Fundacion Portales -- must be involved from the beginning of the research and extension activities in their area of influence. These institutions must also receive full support and technical advice in developing appropriate materials to be broadcast or published on environmental and ecological principles, conditions in the region, and the relation of these factors to the local population's long-term economic advantage in sustainable utilization of natural resources, including protection of such ecosystems as upper watersheds.

TECHNICAL ANALYSES

Natural Resource Management

Introduction

The objectives of this component of the project are to:

- Acquire basic knowledge about the elements and processes relative to traditional resource utilization practices that have a negative impact upon the environment;
- Use that knowledge to develop interventions in the form of appropriate management practices that will reduce environmental degradation and restore the productivity of natural areas; and
- Develop management systems that protect the remaining biological diversity and possibly reclaim degraded habitats and areas of local endemism.

Watershed Management

As so much of the development potential of the project region depends upon the use of water for irrigation and, more critically, upon the regular flow of water in the streams used for irrigation, a key element of the development strategy is the proper management of the water catchment area above the irrigated sites. Downstream investment in irrigation requires that a portion of that investment be devoted to the collection of pertinent data on the water being produced within the watershed, the sediment being transported by the streams, and the areas where management interventions would be most effective.

Due to the visibly low percentage of ground cover in most of the region's watersheds, the apparent erodibility of their soils, and the torrential character of the precipitation, at present we can only speculate that:

- First, the amount of sedimentation of downstream areas is significant;
- Second, the amount of water passing through the system in the form of peak flow, and thus unavailable for irrigation, is significant; and
- Third, the potential for damage to farmland and human settlements due to flooding is substantial.

The research and extension component of the project includes a series of pre-investment studies involving a detailed investigation of the following three selected watersheds in the region:

- The Tucma-Uyuchama watershed -- 70,000 ha;
- The Tipa Tipa watershed -- 4,000 ha; and
- The Calicinto watershed -- 5,000 ha.

These three watersheds are relevant for future project activities as they feed already functioning irrigation systems and are expected to provide water for expanded irrigation systems in the future. The Tucma-Uyuchama watershed, specifically, is also relevant for three additional reasons: first, the impact of flooding on the town of Mizque and its irrigated lands; second, the presence within the watershed of areas of potentially significant biological diversity and local endemism, such as *Puya raimodii*, *Podocarpus sp.*, *Polylepis incana*; and third, the potential development of a small hydroelectric power plant on the Kuri-Tucma river.

Reforestation

The demand for forest products in the project region is increasing while the local forest resource base is being depleted. There is definitely a need for increasing the supply of forest products through reforestation projects, with rapid-growing and adapted species such as pine and eucalyptus. The best results, both in terms of survival of seedlings and productivity of trees, occur in those regions where the rainfall is above 600 mm. The productivity is less where rainfall

is lower. Areas of adequate rainfall in the project region are found at higher elevations and within the uppermost reaches of the many watersheds of the Valles Altos region.

Presently only COTESU/CORDECO operates effectively as an institution capable of executing reforestation projects. Within the project area, their long-term plans include the establishment of pine and eucalyptus forests in the Vacas region. This area is included in the uppermost reaches of the Tucma-Uyuchama watershed which supplies water directly to the Mizque region. The reforestation of the Vacas region, 540 hectares over three years, will also have a positive effect in reducing soil erosion and in the regulation of the hydrologic cycle in the Uyuchama-Tucma watershed.

This planned activity will involve the use of exotic species -- primarily pine and eucalyptus. Eucalyptus has grown in Bolivia for more than 150 years; many of the pine species for several decades. Species of both these genera are poor choices for erosion control or land rehabilitation. Sites chosen for planting these species must be reviewed by competent experts in ecology and soil conservation to ensure that the species used are appropriate for the goals of the plantation activities in watershed protection. Additionally, anticipated market values of these species must be determined to assure that the farmer will receive the greatest benefit from the use of the scarce land resource. Native species of trees and shrubs, inherently adapted to local conditions, are preferred for watershed protection, but only if direct economic returns from anticipated sales of timber are not a primary goal of such plantations and if exotic species are not projected to have greater economic returns.

Forest Inventories and Industries

While the natural resource base of the region is to a large extent degraded, there are also areas whose ecosystems could be better exploited in order to sustain their productivity and to provide a wider range of products. Extensive areas of xerophytic forest in the Aiquie-Mizque region could thus become important and reliable sources of forest products in support of small artisanal activities such as the manufacture of musical instruments or furniture. These forest resources require proper inventories and management plans in order to fulfill their productive potential.

Institutional Support

One of the major obstacles in the planning and the proper execution of resource management plans in the region is the paucity of qualified technicians and capable executing agencies. It is absolutely essential that the project assist in the strengthening of the only specialized educational institution in the region in its effort to train mid-level educational technicians. Moreover, the institutional support provided to ETSFOR in Cochabamba will specifically orient teaching and research efforts toward the management of the resources of the highland region, the intermontane valleys, and the high altitude pastures. It will also strengthen the training capacity of the school by supporting a new agroforestry program. Agroforestry and sylvopastoral techniques are critical inputs in a national resource utilization strategy for the region.

Extensive Grazing Practices

The project area offers a complex environmental scenario. Many of its components, such as its bio-geologic and hydrologic elements, are to a large extent unknown. Even less known are some of the interdependencies between human activities and the natural resources and ecosystem processes. But one can easily see that the immediate trends are toward the degradation of the affected ecosystems, the loss of biological diversity, and the deterioration of the fragile life-supporting systems (hydrologic balance, potable water renewal, and nutrient cycles), whatever the interaction between the human populations and the ecosystems may be.

The slopes and high altitude pastures within the project area are used extensively for grazing. Cattle, goats, and sheep graze and browse on the natural vegetation of the entire region. Livestock pressure in many areas has exceeded the carrying capacity of the resource base and caused the loss of its productive capabilities. Specifically, overgrazing has caused the degradation of forest lands, the reduction of ground cover density, the change in its composition, and the loss of top soil -- in some cases irretrievably.

Traditional extensive grazing practices also have important social, economic, and cultural implications. The significance of each of these is not clearly known. Moreover, the understanding of the ecological, socioeconomic, and cultural

implications of extensive grazing practices is fundamental in the development of appropriate mechanisms to transform these practices in ways to make them more productive and sustainable.

The research project is aimed at obtaining relevant answers to the problem of overgrazing and at supplying appropriate technological packages for improving the traditional systems. These technologies will in turn become critical inputs in the watershed management strategies to be implemented in the project region.

Pesticide and Water Pollution Control Program

Introduction

This program will be executed as part of the activities carried out by the pre-investment studies and research and extension components of the project. Specific activities which may be affected by this program are discussed below.

Pre-Investment Studies for Irrigation and Potable Water Systems

These studies will be carried out under the supervision of the irrigation and ecologist/hydrologist advisers. The control program will include two activities:

- Water sample analyses for contents such as pathogens, pesticides, organic compounds, fertilizers, and mineral salts; and
- Water sample analysis for solid sediment content.

Sediment volume control should be performed by means of adequately designed sedimentation ponds for most irrigation systems planned for construction or rehabilitation. Special priority should be given to those irrigation systems associated with watershed management plans, livestock management alternatives, and gully control treatments. In the case of the latter, exclosures and experimental plots should be established, whenever possible, in order to determine the effect of appropriate management practices on erosion and sediment transport. These exclosures should be associated with control plots, and sediment originating from them should also be collected and measured.

Pre-Investment Studies for Hydroelectric Development Projects

The only specific area under consideration is on the Kuri-Tucma river. The possible components to be considered will be determined by the planned CUMAT study of land-use capability in this watershed, and specific recommendations for monitoring must be stated in any plans for this activity.

Integrated Pest Management Studies

These will be conducted as part of the agricultural development activities, the agroindustry feasibility studies, and the forestry activities being planned. Water quality determinations will be necessary, but will depend upon the specific IPM activities to be implemented. Pesticide and fertilizer analyses should be performed on all potable water systems being planned.