THE WORLD BANK/IFC/M.I.G.A.

OFFICE MEMORANDUM

DATE: March 8, 2001

TO: Mr. Ken King, Assistant CEO, GEF Secretariat
Att: GEF PROGRAM COORDINATION

FROM: Lars Vidaeus, GEF Executive Coordinator

EXTENSION: 3-4188

SUBJECT: **Regional: Integrated Silvo-Pastoral Ecosystem Management**
Submission for Work Program Inclusion

Please find enclosed the electronic attachment of the above mentioned project brief for work program inclusion. We would appreciate receiving any comments by March 15, 2001.

This innovative project seeks to address multiple global environmental issues through an integrated approach to land management in 3 countries. The proposal is consistent with the *Criteria for Review of GEF Projects* as presented in the following sections of the project brief:

- **Country Drivenness**: Each of the participating countries (Colombia, Costa Rica and Nicaragua) have ratified the CDB and have identified conservation and sustainable natural resource management as a priority. In addition, the national guidelines and policies of each country have emphasized a need for an integrated ecosystem management approach for sustainable development. This has also been reflected within each country's respective CASs. Please see section B1a-b. (*Sector-Related Country Strategy & National Environmental Strategies Supported by the Project*) on page 2, for further discussion of country drivenness and D4 on page 20 (*Indications of borrower and recipient commitment and ownership*) for a discussion of focal point involvement in project's endorsement.

- **Endorsement:** the national GEF focal point has provided an endorsement letter on:

1. Colombia, Ministerio del Medio Ambiente, MMA: November 22, 2000
2. Costa Rica, FUNDECOOPERACION: January 26, 2001
3. Nicaragua, Ministerio del Medio Ambiente y Recursos Naturales, MARENA: October 27, 2000

- **Program Designation & Conformity:** This project applies the Integrated Ecosystems Approach to redress land degradation caused by open rangeland for livestock production in three representative regions within each of the countries. It supports complex land management systems that increase biodiversity habitats (including soil biodiversity), increase carbon sequestration, reduce soil erosion, and enhances water management, while improving socio-economic conditions in rural

areas. As such, with its emphasis on the integrated ecosystem management aiming to improve both land, water and bio-diversity of degraded pastures, the project fully supports the requirements of OP #12. Please see Section B1(c) page 3 *(GEF operational strategy/program objective addressed by the Project*).

- **Project Design:** : The project design has been formulated to combat forest loss and land degradation by addressing underlying causes and issues surrounding sustainable natural resource management through incorporation of land-management techniques that generate multiple social and environmental benefits. Specific project components include: (i) ecosystem enhancement and capacity building, (ii) monitoring and evaluation of ecological services, (iii) establishment of an Ecoservice Fund, (iv) supporting and influencing policy formulation, outreach and sound project management. Please see section C on page 10 (*Project Description Summary*), Annex 1 (*Project Design Summary*), and Annex 2 (*Detailed Project Description*).

- **Sustainability:** Past experience has indicated that once silvopastoral systems are established, they remain viable for least 20 years while continuing to provide local and global environmental impacts and benefits. In addition, the integration of local participation, training and capacity building into the project design promote the use of improved agricultural techniques and an increased sense of stewardship. See Section F1, (*Sustainability*) on page 29.

- **Replicability:** Replicability is a key project component. Project activities include various means of information dissemination: through establishment of demonstration sites, seminars, workshops, regional consultations and publications. These activities will allow for wide dissemination to promote improved silvopastoral techniques by improving extension services and fostering farmer-to-farmer knowledge sharing. Much of the information generated from project activities will be housed in LEAD's Virtual Research and Development Centre and would be available for replication in other regions. See Section E7 (*Participatory Approaches*) on page 27.

- **Stakeholder Involvement**: Throughout project preparation and implementation, stakeholder involvement plays a key role. For identification of project stakeholders, please see Section C3, page 11 (*Benefits and target population*); for a summary discussion of the involvement of stakeholders in preparation and implementation, please see Sections E5, page 23 (*Social*) and E7, page 26 (*Participatory Approaches*); for a detailed discussion of the issues, please see Annex 8 (*Social Assessment Summary*).

- **Monitoring & Evaluation:** Given the pilot nature of this project, the M&E component is of fundamental importance. As discussed in detail in Annex 7, monitoring of biological and socio economic trends would be assured by monitoring programs in the baseline and as well as methods that will be established under the proposed project. The set of indicators on the environmental and economic impacts of project outputs and activities have been developed and are presented in Annex 1 (*Project Design Summary*) and Annex 2 (*Detailed Project Description*), respectively.

With regard to M&E of project administration, CATIE will act as the central executing agency and will be directly responsible for managing activities in Costa Rica while subcontracting NITLIPAN and CIPAV for overseeing project sites in Nicaragua and Colombia respectively. In each country the local project coordinator and financial project manager would be responsible for constant monitoring and evaluation to determine the success of project administration. For more details please see Section C4, page 12 (*Institutional and Implementation Arrangements*) and page 15 (*Project Monitoring and Evaluation*).

- **Financing Plan**: A summary of the project cost table is presented in Section C1 page 10. A summarized financial analysis can be found in section E1 (a) on page 21. Additional information can be found in Annex 3 (*Estimated Project Costs*) and Annex 4 (b) (*Financial Summary*). The breakdown between baseline funding and incremental costs and the rationale for GEF support may be found in Annex 4(a) (*Incremental Costs and Global Benefits*).

- **Cost-effectiveness**: Given the methodological difficulties in quantifying and valuing environmental services generated by the proposed project, a financial and economic cost-effectiveness analysis was conducted. In this analysis, the discounted costs of the program are compared with the costs of alternative investments. Information on cost effectiveness of the project can be found in Section E1(b) on page 21 and in Annex 4 (c).

- **Core Commitments and Linkages**: As stated above, the project is consistent with WB Country Assistance Strategies in each country. The project complements on-going WB operations focussed on addressing poverty alleviation, natural resource management and biodiversity conservation. Please see the discussion of the project's linkage to the WB Country Assistance Strategy in Section B1 on page 2, and how the project complements other on-going Bank projects in Section D2, page 16.

- **Consultation, Coordination and Collaboration between IAs**: Upstream consultations have ensured that there is complementarity UNDP activities (please refer to comments provided from UNDP on Dec 20, 2000). It should be noted that the Colombian component of the WB regional project focuses on the re-conversion of extensively degraded livestock systems into silvo-pastoral systems, whilst the UNDP Massif project centers on strengthening the protection of highly valued montane forest and paramo vegetation. We will continue the interaction with UNDP to ensure that demonstration site selection is done in coordination, and to ensure that there is no geographical overlap. For more details please see Section D2 on page 16-18 (*Major related Projects financed by the Bank and/or other development agencies*) for a discussion of the other programs with links to the proposed project. For coordination with other GEF-supported initiatives in Colombia Andes, see Annex 10 *(Complementarities among GEF projects in the Colombia Andes).*

- **Response to STAP Expert Comments**: An expert from the STAP Roster (Dr. Pedro Sanchez- Director, ICRAF) reviewed the project in January 2001 and found that the project was "highly innovative and worthy of funding…." Please see and Annex 9 (*Comments of the STAP Review*) to review outstanding issues and corresponding responses and comments by the preparation team.

- **Response to GEFSEC Review at the time of initial Pipeline Entry (October 2000)**: in their comments of October 2000 the Secretariat team recommended that the preparation team look at a number of concerns and issues. These have been carefully addressed in the preparation of the Project Appraisal Document (PAD). GEFSEC comments (in italics) have been addressed as follows:

  (a) LEAD is not eligible as a proponent of a GEF project; it has to be a developing country institution;

  CIPAV, CATIE and NITLAPAN are now presented as project proposers. CATIE will be the executing agency . ABC and LEAD are now presented as international project partners and cofinanciers under item C (4) and in Annex 5 *(Institutional Analysis: Executing Agencies and Project Partners*).

  (b) GEF funds cannot be used to finance the regular programs of international organizations. The proposed project activities appear to be the same as the programs of LEAD and American Bird Conservancy (ABC) described in the project document. Also, because of this similarity there may not be incremental cost for GEF to cover;

  ABC and LEAD descriptions are now in Annex 5 as project partners and co-financiers. Mentions to their international programs were removed.

  (c) Clarify the role of ABC in the project. The document suggests that it will be the executing agency. We are requesting justification why institutions from the participating countries that are ably executing other GEF project will not be in a position to do so in this case;

  ABC is not the executing agency but a co-financier. Changes to ABC and LEAD roles have been included under C(1):Project Components. Role of ABC clarified under C 4 (Institutional and Implementation Arrangements). Details are found in Annex 2 (Detailed Project Description) and Annex 7 (Monitoring and Evaluation Plan), where the methodology for Monitoring Biodiversity prepared by ABC is described. This method will be used in Project Monitoring.

  (*d) Rationale for choosing three countries. We are requesting information on the added-value to lessons learned, etc. of implementing this demonstration project in three countries instead of one country;*

  In D1 Project rational (page 17), under Regional vs. National Approach the question is addressed in the first paragraph.

(e) The GEF cannot make cash payments (into a fund) for carbon sequestered;

There will not be cash paid for carbon sequestered, but about action/investment grants for activities in the farm leading to carbon sequestration.

(f) The ratio of GEF financing to co-financing should be at least 1:1;

Ratio exceeded in current document (Baseline $ 9.7 million; Project Alternative $ 18.1 Million; Incremental Cost: $ 8.4 million, of which GEF $ 4.5 million).

(g) *The following were noted in the document as important in addressing barriers to the adoption of silvopastoral system, but they are not included in project design -- fair trade agreements and certification of livestock products, and ecotourism;*

These activities are now describe as extra benefits of silvo-pastoral systems in section E6 (page 26), and they are described in Annex 2 *(Detailed Project Description).*

(h) One of the activities suggested in the project is the development of computer programs for modeling carbon sequestration. We are seeking clarification on how this will add value to the promotion by policymakers, farmers, etc. on the ground.

This activity is now better described in C1 and C2, and in more details in Annex 2 *(Detailed Project Description).*

Please let me know if you require any additional information to complete your review prior to inclusion in the work program. Many thanks.

Distribution:

Messrs.: R. Asenjo, UNDP
A. Djoghlaf, UNEP (Nairobi)
K. Elliott, UNEP (Washington, DC)
M. Gadgil, STAP
M. Griffith, STAP (Nairobi)
Y. Xiang, CBD Secretariat
C. Parker/M. Perdomo, FCCC Secretariat

cc w/o attachments: Messrs./Mmes. Dowsett-Coirolo (LCC2C); Olivier (LCC1C); Redwood, Serra (LCSES)

cc: Messrs./Mmes. Ribe (LCSHD); Brizzi (LCC1C); de Haan (RDV); Cackler, Agostini, Bradley (LCSES); Khanna, Aryal, Castro (ENV)

ENVGC ISC

LCSES IRIS 4; LCSES IRIS 1.

PROJECT BRIEF

1. IDENTIFIERS:

PROJECT NUMBER:	P072979
PROJECT NAME:	**Regional (Colombia, Costa Rica, Nicaragua): Integrated Silvopastoral Approaches to Ecosystem Management**
DURATION:	5 years
IMPLEMENTING AGENCY:	World Bank
EXECUTING AGENCY:	CATIE (Centro Agronomico Tropical de Investigacion y Ensenanza)
REQUESTING COUNTRY OR COUNTRIES:	Colombia, Costa Rica, Nicaragua
Eligibility:	Colombia: CBD November 3, 1994 UNFCCC March 22, 1995 Costa Rica: CBD August 26, 1994 UNFCCC August 26, 1994 Nicaragua: CBD November 20, 1995 UNFCCC October 31, 1995
GEF FOCAL AREA:	Biodiversity, Carbon Sequestration, Land Degradation
GEF PROGRAMMING FRAMEWORK:	OP12 - Integrated Ecosystem Management

2. SUMMARY:

The development objective of this highly innovative pilot project is to improve eco-systems functioning of degraded pasture lands in Colombia, Costa Rica and Nicaragua, through the development of more intensive silvopastoral systems that provide global environmental services and local socio economic benefits. As such, the project aims to demonstrate and measure, at farm and community level, the benefits of an integrated ecosystems approach to the improvement of degraded pasture lands in terms of: (a) local environmental benefits through reduction in erosion and improvement in soil and water quality with increased production, income and employment in rural areas; (b) global environmental benefits, through improved biodiversity and carbon sequestration services: (c) initial experiences in the management of incentives required to produce global environmental benefits; and (d) the development of comprehensive guidelines for sector and environmental policies in terms of land use, environmental services and socio-economic development provided by the introduction of silvopastoral systems to rehabilitate degraded pastures.

3. Costs and Financing (Million US):

GEF:	Project:	4.50
	PDF B:	0.27
	Subtotal GEF:	**4.77**
Co-financing of the Increment:		
CATIE, CIPAV, NITLAPAN		0.60
LEAD		0.35
ABC		0.05
Beneficiaries		2.90

Baseline Co-financing:	Colombia Ministry of Agriculture and Ministry of Environment, World Wildlife Fund, Ecofondo, Holland and the Private Reserves, Ecofondo, Red Nacional de Reservas de la Sociedad Civil, private farms, ABC, World Bank/MMA, AVINA, CATIE, Hacienda Pacificam, FINIDA, FAO, EU, UCR, ILRI, CIAT, CAC, Ministry of Agriculture of Costa Rica, Catholic Church, Taiwan Government, Ministry of Agriculture of Nicaragua
Total Project Cost:	The cost of the baseline scenario is US$ 9.7 million; The cost of the GEF alternative is US$ 18.1 million; The incremental cost is estimated at US$ 8.4 million.
4. Associated Financing (Million US$)	N/A
5. Operational Focal Point endorsement:	
Claudia Martinez Zuleta	Viceminister of the Environment, Republic of Colombia, November 22, 2000
Lic. Milton Rojas Z.	Responsable, Punto Focal GEF, San Jose, Costa Rica, January 26, 2001
Garcia A. Cantarero	GEF Focal Point, Managua , Nicaragua, March 5, 2001
6. IA Contact:	Theresa Bradley LAC Tel. # 202-473 0016 Fax: 202- 522 0262 Internet: Tbradley@worldbank.org

Report No: 21869-LAC

PROJECT APPRAISAL DOCUMENT

ON A PROPOSED

GRANT FROM THE GLOBAL ENVIRONMENT FACILITY

TRUST FUND OF SDR MILLION (US$ 4.5 MILLION EQUIVALENT)

TO

INSTITUTIONS IN COLOMBIA, COSTA RICA AND NICARAGUA

FOR THE

REGIONAL PROJECT ON

INTEGRATED SILVOPASTORAL APPROACHES TO ECOSYSTEM MANAGEMENT (OP12)

March 06, 2001

Environmentally and Socially Sustainable Development
Central American Department
Latin America and the Caribbean Regional Office

CURRENCY EQUIVALENTS

(Exchange Rate Effective February 26, 2001)
Currency Units Colombian Peso 1$ = 2250 COP
Costa Rican Colon: 1 $ = 316 CRC
Nicaraguan Cordoba Oro 1 $ = 12.9 NIO

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ABC	American Bird Conservancy
ASOMIF	Association of Nicaraguan Microfinance Organizations
BANCAFE	Banco Cafetero
BID	Banco Interamericano para el Desarrollo
CAS	Country Assistance Strategy
CAS	Country Assistance Strategy
CATIE	Centro Agronómico Tropical De Investigación y Enseñanza
CBD	Convention on Biodiversity
CCAD	Central American Commission on Environment and Development
CDM	Clean Development Mechanism
CIAT	Centro Internacional de Agricultura Tropical
CIPAV	Centre For Research on Sustainable Agricultural Production Systems
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
COLCIENCIAS	Colombian Institute for Science and Technology
CREU	Colombian Certificates Of Reduction Of Green House Gases
DANIDA	International Development Agency of Denmark
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FDL	Fund for Local Development
GEF	Global Environment Facility
GTZ	German Technical Cooperation Agency
IDR	Instituto de Desarrollo Rural
IFS	International Foundation for Science
ILRI	International Livestock Research Institute
INBIO	Instituto Nacional de la Biodiversidad Costa Rica
LEAD	Livestock, Environment And Development Initiative
MARENA	Ministerio del Ambiente y los Recursos Naturales de Nicaragua
MBC	Mesoamerican Biological Corridor
MINAE	Ministry of Environment and Energy Costa Rica
MINAMBIENTE	Ministerio del Medio Ambiente de Colombia
MSP	Medium Size Project
NITLAPAN	Institute of Research and Development of the University of Central America
OCIC	Oficina Costaricense de Implementación Conjunta
PAD	Project Appraisal Document
PIF	Partners In Flight
SIDA (ASDI)	Swedish International Development Agency
SIDE	Servicios Internacionales para el Desarrollo Empresarial
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WWF	World Wildlife Fund

Vice President: David de Ferranti
Country Director: Donna Dowsett-Coirolo, Olivier Lafourcade
Sector Director: John Redwood
Task Manager: Cees de Haan
Co-Task Manager: Paola Agostini
GEF Coordinator for Latin America: Theresa Bradley

REGIONAL

INTEGRATED SILVOPASTORAL APPROACHES TO ECOSYSTEM MANAGEMENT

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REGIONAL

INTEGRATED SILVOPASTORAL APPROACHES TO ECOSYSTEM MANAGEMENT

Project Appraisal Document

Latin America and the Caribbean Regional Office

Date: March 05 2001 **Task Team Leader/Task Manager:** Cees de Haan/Paola Agostini
Country Manager/Director: Donna Dowsett-Coirolo, Olivier Lafourcade. **Sector Manager/Director:** John Redwood
Project ID: PO 72979 **Sector:** Environment **Program Objective Category:** NR
Focal Area: Integrated Eco-Systems Management
Program of Targeted Intervention: [ ] Yes [X] No

Project Financing Data [] **Loan** [ ] **Credit** [ ] **Guarantee** [X] **GEF Grant** [ ] **Other**

For Loans/Credits/Others:

Amount (US$m/SDRm): SDR million (US$ 4.85 million equivalent) GEF
Proposed terms: [ ] Multicurrency [X] Single currency, specify US Dollars
Grace period (years): [ ] Standard Variable [ ] Fixed [X] LIBOR-based
Years to maturity:
Commitment fee: Front-end fee:

Financing plan (US$m):

Source	Local	Foreign	Total
CATIE, CIPAV, Nitlapan			600,000
LEAD,			350,000
ABC			50,000
GEF			4,500,000
Beneficiaries			2,900,000
Total			8,400,000

Recipients: CATIE, CIPAV, Nitlapan
Responsible Agency: Same

Estimated disbursements (PY/US$M):

		PY1	PY2	PY3	PY4	PY5
GEF:	**Annual**	1	1.5	1	0.85	0.5
	Cumulative	1	2.5	3.5	4.5	4.5
TOTAL:	**Annual**	2	2.3	2	1.2	0.9
	Cumulative	2	4.3	6.3	7.5	8.4

Project implementation period: 5 years
Expected effectiveness date: August 1, 2001 **Expected closing date:** July 31, 2006

Implementing agency: World Bank
Contact person: Theresa Bradley- Cornelis de Haan – Paola Agostini
Address: **1818 H St – NW Washington DC 20443**
Tel: 1(202)473-0347 **Fax:** (1 202) 522-0262 **E-mail:** tbradley@worldbank.org; cdehaan@worldbank.org; Pagostini@worldbank.org

A: Project Development Objective

1. Project Development Objective: (see Annex 1)

The development objective of this highly innovative pilot project is to improve eco-systems functioning of degraded pasture lands in Colombia, Costa Rica and Nicaragua, through the development of more intensive silvopastoral systems that provide global environmental services and local socio economic benefits. As such, the project aims to demonstrate and measure, at farm and community level, the benefits of an integrated ecosystems approach to the improvement of degraded pasture lands in terms of: (a) local environmental benefits through reduction in erosion and improvement in soil and water quality with increased production, income and employment in rural areas; (b) global environmental benefits, through improved biodiversity and carbon sequestration services: (c) initial experiences in the management of incentives required to produce global environmental benefits; and (d) the development of comprehensive guidelines for sector and environmental policies in terms of land use, environmental services and socio-economic development provided by the introduction of silvopastoral systems to rehabilitate degraded pastures.

By focussing on the enhancement of the functioning of entire eco-systems and it's resulting improvement in carbon sequestration, bio-diversity and water quality, the project is directly in line with the objectives of OP12.

1a: Projects Outcomes

The main purpose of the project is to assist local institutions in Colombia, Costa Rica and Nicaragua to upscale, promote, demonstrate and assess the environmental and socio-economic benefits of integrated ecosystems management technologies through the introduction of silvopastoral systems. The benefits of the project would be multiple: conservation and sustainable use of biological diversity, reduction of the risk of climate change by a holistic management approach, equitable participation of local community members in the economic benefits derived from the environmental services and the identification of the foundations for a comprehensive policy dialogue that leads to natural resource management for lasting regional and global benefits. To achieve this, the proposal seeks to deliver the following products:

- Significant areas with improved eco-systems functioning through the introduction of silvopastoral systems (see section 3), as confirmed by soil, water and bio-diversity characteristics;

- Trained stakeholders and strengthened local organisations, which are better informed on integrated ecosystem management and the implementation of sustainable livestock production systems;

- Key scientific information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits;

- Initial information on the response at community and beneficiaries level to incentive systems to produce global environmental benefits through biodiversity conservation and global climate change; and

- Policy guidelines to promote sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use, environmental services and socio-economic development.

For GEF, this pilot activity would provide guidance for future funding, on the definition of policy requirements for environmental services in livestock production and mitigation measures in an area for which operational programs have not yet been developed (carbon sequestration and biodiversity on agroecosystems). The documentation of experience gained, good practices, and dissemination of lessons learned and know-how are also an integral outcome of the project. This will lead to greater awareness of the potential gains to be made in terms of environmental services provided by integrated ecosystem management.

2. Key performance indicators: (see Annex 1)

Key performance indicators related to the project development objective include:

- The increase in area of improved eco-systems functioning to 35,000 ha of currently degraded pasture land, as demonstrated by specific indicators for soil and water quality and bio-diversity

- The number of livestock producers, community leaders, and policy decision makers at the local, regional and national level, familiar with the ecological and economic benefits of more intensive silvopastoral systems in livestock production;

- The availability of improved resource monitoring methodologies developed for measuring carbon sequestration, biodiversity conservation, water quality in watersheds and socio economic aspects; and

- The availability of sets of policy guidelines on benefits sharing mechanisms and institutions related to global and local environmental services provided by integrated ecosystem management.

B: Strategic Context

1 (a). Sector-Related Country Assistance Strategy (CAS) Goal Supported By The Project:

Colombia: The project is consistent with the World Bank's overall objective for the Country Assistance Strategy for Colombia which is to achieve sustainable development with continual reduction of poverty and improvement of social conditions in an environment of peace. The CAS recognises Colombia's global environmental importance and identifies environmental protection and conservation combined with macroeconomic stability to be essential elements to ensure sustainable development. This project contributes to the CAS's strategic focus on sustainable development to: i) improve natural resource management and strategic ecosystem conservation; ii) strengthen the effectiveness of the decentralised environmental management system and seek partnership opportunities with the private sector, NGOs and academia; and (iii) promote employment opportunities for the disadvantaged through environmentally sustainable projects.

Costa Rica: The project is compatible with the World Bank's Country Assistance Strategy for Costa Rica, which directly supports improved incentives for private sector-led growth, improved natural resource management through the conservation of forest ecosystems, and poverty alleviation through targeting small farmers and the rural poor for contracts for conservation easements, sustainable forest management, and reforestation.

Nicaragua: The project is consistent with the World Bank's Country Assistance Strategy for Nicaragua, which identifies the destruction of forests as an issue of major importance for the country, and gives top priority to improving natural resource management.

1. (b) National Environmental Strategies supported by the Project.

Colombia ratified the Convention of Biological Diversity (CDB) on November 3, 1994, and the United Nations Framework Convention on Climate Change (UNFCCC) on March 22, 1995. The Colombian National Policy for Biodiversity (1996) focuses on conservation, knowledge, and sustainable use. National guidelines and strategies include sustainable renewable resource management plans, assessments of economic potential to insure equitable use, protected areas, legislative and institutional strengthening, technology transfer, biodiversity information systems, and community training and participation. National Action Plans call for integrated ecosystem management for sustainable development. The set of national priorities, action plans, and programs related to the project include: National Environment Policy: Collective Environment Project, Green Plan: Forests for Peace, National Policy and National Strategy for Biodiversity, National Policy for Protected Areas, National Plan of Forestry Development, National Strategy for Clean Development, Environmental Alliance for Colombia, National Plan for Research and Development in Agroforestry systems and National Plan for Environment and Habitat Management.

The project is also compatible with the recent National Strategy Study "Optimization of the Use of the Clean Development Mechanism in Colombia", which assists the Government of Colombia to conduct an assessment of the potential for cost-effective reduction of emissions and potential capture of greenhouse gases; to evaluate the market for Colombian certificates of reduction of green house gases (CREUs); to define the regulatory and institutional requirements to promote the development of a market for CREUs; to support Colombia's positioning before the conference of parties to the Climate Change Convention; and to identify an initial portfolio of projects that could be submitted to the carbon trade market. The benefits foreseen in this plan are: the promotion of combination forest protection/sustainable rural development programs that could improve the welfare of indigenous and minority communities, protect Colombia's unique biological resources, and possibly displace illicit crops (some of the projections made through the study indicate that the combined incomes from CREUs and the net co-benefits from sustainable reforestation and agroforestry programs, could well provide enough economic incentives for displacement of illicit crops). The sale of CREUs from forestry programs and natural regrowth could also provide for the recovery of watersheds and control of erosion and other tangible benefits associated with the protection of biodiversity and genetic resources.

Costa Rica ratified the CBD on August 26, 1994.and the UNFACC on the same day. This project is closely linked to the Action Plan of the Costa Rican National Biodiversity Law of April 14, 1998 (No. 12635), which states that the sustainable use of biodiversity should preserve all development options for future generations (including food security, ecosystem conservation, and improved living standards), foster cultural diversity, enhance knowledge of biodiversity, and increase conservation activities, particularly of rural, indigenous communities. Project activities also comply with the Forestry Law No. 7575, approved in 1996, which supports the conservation of forest ecosystems and provides incentives to individuals and groups that implement conservation measures. The project is also directly compatible with current activities of the Ministry of Environment and Energy (MINAE) and the National Biodiversity Institute (Instituto Nacional de la Biodiversidad – InBio) at the national level -- and specifically in the project area (Esparza and La Fortuna, San Carlos) that support biodiversity conservation both inside and outside of the proposed project areas. Esparza is in close proximity to the Monteverde Reserve Complex and La Fortuna to the Arenal Reserve and both sites are important for conservation of biodiversity.

The project is also compatible with current activities on climate change in Costa Rica. Costa Rica signed the United Nation Framework on climate change (1992) and the National Meteorological Institute is responsible to report greenhouse emissions from land use and land cover change. Costa Rica has over 1.5 million ha degraded pasture lands that contribute to emission of greenhouse gases (Veldkamp, 1993). This project would promote the adoption of improved silvopastoral systems, which would contribute to recovery of degraded pasturelands and mitigation of green house gases. Additionally Costa Rica has also established an office "OCIC" (Oficina Costaricense de Implementación Conjunta) which is responsible for marketing of projects under the clean development mechanism (CDM).

Nicaragua ratified the CBD on November 20, 1995, and the UNFCC on October 31, 1995. Nationally these conventions are reflected in the governments participation in the Central American Alliance for Sustainable Development, under which it has adopted the Mesoamerican Biological Corridor as an instrument for planning and prioritizing investments. The Regulations for Protected Areas (issued by Decree 14-99 on March 2, 1999) requires all protected areas to issue a management plan based on community development, biodiversity value estimation, and environmental services valuation. The project is consistent with the Environmental Services Office, created within the framework of the Protected Areas, to identify indicators and to value the environmental services of the protected areas and buffer zones. The project is also consistent with the biodiversity and forest conservation policies stated in the General Law for the Environment and Natural Resources (L. 217 from March 26, 1996), its regulation (Decree 9-96, of July 25, 1996), the Nicaraguan Strategy for Conservation and Sustainable Development, the Environmental Action Plan and the Forestry Action Plan.

1. (c) GEF Operational Strategy/program objective addressed by the project:

With its emphasis on integrated eco-systems management aiming to improve both land, water and bio-diversity of degraded pastures, the project fully conforms with the requirements of OP 12 (integrated ecosystems

management). Other GEF focal areas that the project falls into are Biodiversity and Climate Change.

This project would apply the Integrated Ecosystems Approach to re-dress land degradation caused by the establishment of open rangeland for livestock production in three targeted regions in Nicaragua, Costa Rica and Colombia. Pasture degradation is a common problem throughout Latin America, in particular this applies to cattle production in tropical hillsides and areas of forest margins. It is estimated that more than forty percent of tropical pastures are in an advanced stage of degradation. The three targeted countries have different ecosystems in terms of land use potential, actual degree of degradation, and the socio-economic setting of production, and have local organisations with different institutional capacity and comparative advantages. The broad range of eco-systems covered by the project would enable the results of the project to be transferred to other countries in the region.

The ecosystem approach, as intended here, is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The application of the ecosystem approach would help to reach a balance of three interlinked objectives: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilisation of natural resources. Multi-purpose farming and agroforestry practices applied to livestock production enterprises, opens new avenues for linking structures, processes, and functions of the ecosystems for sound agricultural development and conservation. This is the essence of eco-systems management. Central and South America have the greatest bird diversity and some of the most beautiful habitats in the world. Like much of the rest of the world, Latin America is beset by ecological crises all stemming from the root problem of a rapidly growing human population and subsequent demand for natural resources. Thus the ecological problems are underpinned by social problems. And so, it is critical to remember that any solutions to ecological problems must consider local people and cultures.

Specifically, the project is compatible with OP12 opportunities to achieve multiple focal area benefits because it would introduce:

- Integrated approaches towards the rehabilitation of degraded ecosystems; aiming to optimise ecosystem services including reducing emissions and improving storage of greenhouse gases, enhancing water quality and storage capacity as well as restoring and improving biological diversity.
- A holistic approach to a discrete eco-system, i.e. a watershed, addressing comprehensively the prevailing production systems, i.e. extensive rangelands, food crop production, forestry and shifting cultivation.
- Integrated management of the key components of the eco-system by enhancing agrobiological diversity, land, water and energy resources in agricultural production systems cultivation.

2. Main Sector Issues in the Region:

Despite significant efforts to reduce destruction of tropical forest and protect the natural habitats and the wildlife populations in Latin America, the beginning of the new century does not look more promising for the preservation of tropical rainforest and biodiversity than the preceding years. Classical approaches to conservation, attempting to preserve pristine habitats within National Parks and other protected areas, are necessary, but insufficient in the face of growing pressure on land. Driven by social and economic pressures, and unsustainable land use patterns, local settlers continue their expansion into the last remnants of native forests. The silvopastoral technology (see section 3) could reduce the pressure, in particular in the buffer zones of those parks, and therefore complement the protected area approach. The project would therefore work in Nicaragua and Costa Rica on ecosystems corresponding to the buffer zone of Natural Parks, while in Colombia the focus is an ecosystem corresponding to a particular biological corridor[1].

Throughout Latin America, landscape transformation is dominated by the establishment of agriculture and open rangeland for livestock production, irrespective of the characteristics of soils, climate regimes and topography (Table 1). Pastures occupy the largest proportion of the agricultural lands in the region, and to a large extent, their profitability is insufficient to sustain human populations. At the same time, the environmental impacts resulting

[1] See Annexes for the description and maps of the boundaries of the ecosystems in the target regions in Nicaragua, Costa Rica and Colombia.

from this indiscriminate form of land use are damaging, and responsible for the current threats to biodiversity conservation in the Neotropics.

About 38 percent (94 million out of 248 million hectares) of Central America's total land area is used as permanent pasture. Land used for extensive grazing has increased continuously over the past decades and most of this increase has been through deforestation. Ranching-induced deforestation is one of the main causes of loss of some unique plant and animal species in the tropical rainforests of Central and South America. In the past, government-backed conversion of forest to other land uses, such as large scale ranching, was one of the leading causes of deforestation. Today poverty, joblessness and inequitable land distribution is forcing many landless peasants to clear the forest for subsistence farming. The decline in productivity and the lack of appropriate technologies in the agricultural frontier force many small farmers to sell cleared land to livestock farmers. Over the last years considerable progress has been made in reforestation, in particular in Costa Rica, providing an overall picture of increasing forest cover. However, the contribution of such replacement plantation forest to bio-diversity and even carbon sequestration and bio-diversity is less than that of the primary forest. Reducing the pressure on the primary forest remains therefore important.

Table 1. Changes in pasture land and forest in Nicaragua, Costa Rica and Colombia (1989-1999).

Item	Colombia	Costa Rica	Nicaragua
Total Cropland (000 ha)	5,460	530	1,270
Total Permanent pasture (000 ha)	40,600	2,340	5,500
% Change/10 years	4.2	8.0	8.9
Total Natural Forest Area (000 ha)	54,060	1,428	6,027
% Change/10 years	-6.4	-25.7	-17.1

Source: WRI, 2000

From this perspective, alternatives to livestock production in Latin America need to be urgently found. Such alternatives should, while helping people to improve their living conditions, also reduce negative impacts on nature and even restore unpaired environmental services. The proposed use of silvopastoral systems (see section 3) would be one of the most promising holistic approaches to achieve this win-win situation for environmental and social sustainable development, and is therefore the foundation of this project.

3. Sector Issues To Be Addressed By The Project And Strategic Choices:

Cattle and Environment:

Issue

Cattle production has been questioned for a long time because of its association with deforestation and subsequent degradation of soils. In most countries, the prevailing policy framework encouraged deforestation for timber extraction and conversion of forest areas to pastures and crops. Land titles were granted only after the forest was cleared. Furthermore, cattle production was encouraged by subsidised credit, guaranteed prices and other incentives. The policy scenario has changed in the recent years in two ways. On one hand, subsidies for cattle production have largely been ceased, and resource allocation is now more in line with market prices. As a result, pasture lands are now being allocated to alternative uses and the less profitable cattle operations are disappearing. On the other hand, there is a growing number of incentives for the conservation of natural resources and for the provision of environmental services, which is starting to become another factor determining land use.

Strategic Choice

Conventional pasture lands are based on high performance grasses under mono-culture and the intensive use of

capital, machinery, and imported inputs such as fertilisers, pesticides and herbicides. These conventional production models, degenerate after an initial period of high yields, as soil fertility gets depleted, and grass cover diminished, causing environmental degradation such as soil erosion, contamination of water supplies, air pollution and loss of biodiversity and degradation of landscapes. Silvopastoral systems could revert these trends. These systems are a type of replacement vegetation, which to a large extent mimics forest ecosystems As opposed to the pasture lands silvopastoral systems are not seen only as a cattle production system but as integrated farming system that has multiple functions to sustain productive animals, improve soil quality, increase biodiversity and to provide economic sustain for the family.

Silvopastoral systems are a complex array of planted trees, shrubs and grass species with cattle grazing and browsing, in which a range of environmentally beneficial farming practices based on both old proven ideas and a new understanding of natural nutrient cycles and ecological relationships are put in place. Trees are used not only for producing feed for the animals but also for several uses such us live fences and windbreaks, to reduce wind and water erosion, shade for crops and livestock, climbers for vine crops, food production for human (fruits), poles for livestock housing; to store crop residues and to dry grasses; as materials for farm implements, timber for housing and wood for handicraft, traditional medicine, source of pollen for bee keeping and fuelwood among others**.** They serve as an effective "pump" in recycling mineral plant nutrients from deeper soil layers.

Silvopastoral systems are based on the application of each one of the following principles: abundant biomass and energy, diversity of plant species, intercropping, hedges, living fences and biological corridors, efficient use of manure, diversity of habitats and reduction in the use of pesticides and other toxic compounds.

Several systems of alternative ranching have been recently developed in the Neotropics. These can be grouped in three major categories (Murgueitio 1999):

- Forest plantations with livestock grazing: In the tropical lowlands, some plantations of fine wood have as the main associated cost the invasion by different grasses (both native and exotics). Recently, this situation has been managed by introducing cattle, which has resulted in the livestock paying for much of the management costs of the plantations (Londoño 1996).

- Live fencing, wind-protection shields, biological corridors and shade for animals: This system utilises fast growing planted trees and shrubs that not only provide an inexpensive alternative for fencing, but also supplements the diet of the livestock. In some cases, the system develops into actual biological corridors connecting remnants of the original forests through a network crossing the agricultural lands. Naturally, the importance of living fences as corridors increases with size, structural complexity and plant species diversity.

- Intensive systems for cattle and other animal species: Intensive systems for cattle and other livestock, planting through seed or vegetative material in the existing degraded pasture, mixtures of mostly Nitrogen fixing trees, shrubs, grasses and legumes (reducing the amount of land required for ranching thus possibly freeing some areas for natural forest regeneration or for agroforestry), as a diet supplement while protecting the soil from compaction and erosion. There are two types:

  a) High arboreal density silvopastoral systems , where a variety of different trees and shrubs (mostly native) are planted in the degraded areas together with grasses and herbs, and used for grazing afterwards.

  b) Cut and carry systems, where grazing in open pasturelands is replaced by stables in which livestock is fed with the foliage of different trees and shrubs specifically planted in areas formerly used for other agricultural practices. This system is particularly successful in Central America for raising goats and in Colombia for a variety of animals including cattle, horses, goats, sheep, water buffalo, rabbits, guinea pigs, and poultry.

Silvopastoral systems provide a deeply rooting, perennial vegetation which is persistently growing and which have a dense but uneven canopy. In ecological terms, silvopastoral systems are thus much superior alternative to prevalent pasture-only cattle production in Latin America. Initial research in Colombia shows that the mixed vegetation of silvopastoral systems accumulates a substantial amount of carbon per ha, and has one of the highest bio-diversity indexes for many animal classes, including birds (Annex 6). Detailed descriptions of the particular system used in each individual site, is provided in annex 2. Photo examples of silvopastoral systems are provided

below.

High arboreal density silvopastoral systems

Live fencing, wind-protection shields, biological corridors and shade for animals

Socio-economic problems linked to livestock grazing:

Issue

While the socio-economic context among Latin American countries varies widely, the deforestation issue can be taken, at least in part, as an institutional failure. Contrary to what happened in past, where deforestation was caused by the expansion of large ranches, most deforestation is now linked to encroachment of small holder food crop and cattle producers, who are escaping from resource pressure and poverty elsewhere. The lack of economic opportunities in most rural areas is often compounded with deep social crises characterised by violence and skewed distribution of resources. The diversity of situations, involved stakeholders, and environmental impacts of ranching must be recognised in order to transform the current systems into activities compatible with socio-economic development and the protection of nature.

Strategic Choice

Alternative production systems (such as the silvopastoral system) have greater financial and social benefits when compared with conventional cattle raising. According to Murgueitio (2000), silvopastoral systems have greater financial and social benefits, because of their increased productivity and labour requirements when compared to improved pastures and conventional ranching. The employment generation effect is particular important, as it might reduce urban drift and social unrest in the rural areas. Other socio-economic benefits are: diversification of farms products, landscape maintenance, and land improvement.

Adoption of silvopastoral systems

Issues: Barriers

Conventional cattle raising is characterised low production costs and low market risks because of low labour and capital requirements. Silvopastoral systems offer greater socio-economic benefits in terms of income and employment generation, opportunities for conservation and local and global environmental benefits but also carry higher production costs in labour for the establishment of the system and in capital for the complementary investments for additional cattle and agricultural equipment needed to utilise the increased biomass production efficiently.

The reluctance of most producers to convert their enterprises into silvopastoral systems, is based on limited knowledge and on lack of financial incentives to compensate for the high initial investments. More specifically:

1.Financial. Financial limitations during the initial stages of establishing silvopastures, namely the costs of converting degraded grass monoculture into silvopastures, and the time lags resulting from the delays before the systems become productive, are important barriers to adoption of silvopastoral systems. Initial calculations show that a rapid expansion of this more intensive land management technology is constrained by returns to labour, and to capital which are lower than from the traditional slash and burn practices.

2.Knowledge. There is a lack of awareness on the aggregate performance of silvopastures under farmers who could potentially adopt them. Benefits, such as the reduction in the dependency on chemical fertilisers and pesticides, saving water for irrigation, harvesting fuel wood and timber, soil protection and enhanced fertility are well documented but not well know, but can be attractive to potential investors. To promote better awareness, innovative technology transfer approaches would be required. Unless new approaches to technological transfer to promote the implementation of alternative systems are developed, it is very unlikely that the expansion of silvopastoral systems will proceed at a rapid pace.

3.Policy. Key constraints affecting wide spread adoption of the silvopastoral technology include the insecurity of land tenure, also for smallholders and the absence of pro-environment titling procedures and taxation regimes, and the in-equitable access to inputs and markets. Below real market prices of chemical inputs (pesticides and fertilisers) also favours traditional grass based monoculture. Finally, government lack of support for community empowerment poses also an initial difficulty of establishing multi-purpose agroforestry systems.

Strategic Choice: Lifting the Barriers

The project would address the financial, knowledge and policy barriers in the following fashion:

Barrier 1. *Financial barriers.* First, during appraisal, the financial profitability of the silvopastoral technologies will be closely assessed, and a description on the required type and level of funding will be provided in the final appraisal document. On the basis of the initial calculations, and in view of the demonstrative character of the technology, it is highly likely that financial support will be required to launch the technology. This would be through an Eco-service Fund to be established under the project. This Fund would provide investment support for the initial establishment of the silvopastoral technology at the level of 50 percent of total costs for inputs (seeds, fencing, etc) and hired labour for the establishment of silvopastures. This will probably be sufficient to "tip the balance" with a number of farmers, although it would likely not establish the comprehensive area coverage, involving all farms, needed to get the increased eco-systems functioning of an continuous area or entire watershed.

Moreover, in recognition of the global environmental services provided by silvopastoral technologies, to obtain experience with the payment for such services, and to assess how such payments affect farmer behaviour, additional support through the Eco-services fund is envisaged. This would be in the form of a performance grant, which would be used to fund expansion of silvopastoral systems. The payment would be based on an assessment of the improvement in eco-systems functioning as measured by an index combining changes in vegetation cover, relative abundance of plant species and soil and water quality. Payments might cover land set-aside for ecological purposes, as a forest, for example, inside the same farm, as part of an integral land use plan of the farm, and in recognition of its multi-functionality. Such a system of payment for ecological land use would provide the farmer with the option to have silvopastures in the entire farm, but also to establish a biological corridor (for biodiversity or to sequester carbon). Such a set-aside for environmental services would not provide direct income and would therefore justify additional payments. In general, such payments would provide insight in farmer reactions to environmental performance based incentives, which could be used later in, for example, payment for carbon sequestration for the mitigation of greenhouse gasses.

For the payment for services provided for bio-diversity, individual farm performance is less important, as issues, such as the entire landscape and its biological connectivity play a critical role. The performance incentives for bio-diversity would therefore be based on area-wide indicators, and the incentives would be provided to the community. Details are provided in Annex 4.

Barrier *2. Knowledge* With the significant amount of technical assistance provided on implementing beneficial

silvopastoral systems successful livestock production enterprises currently using silvopastoral systems would act as showcases to demonstrate the multiple benefits of these alternatives. Additional techniques of knowledge sharing would be utilized i.e. rancher to rancher extension and participatory communication approaches to replicate the model and transfer experiences to more and more farmers..

Barrier 3 *Policy* . While the above mentioned policy constraints would not constitute insurmountable barriers to the implementation of the project, they would be critical constraints to a wider adoption, and need to be given priority attention. One of the most important outcomes of the project, therefore, would be an analysis of the main policy constraints and the development of decision support models, which would focus on the policy issues regarding input and output incentives (including payment for environmental services), land tenure and titling procedures. The analysis and decision-support models would be developed in close co-ordination with the forest-pasture programme of the Livestock, Environment and Development (LEAD) Initiative, which seeks to identify the policies and technologies needed to stem horizontal expansion of livestock production. A basic conceptual element is the "provider-gets-principle" i.e., environmental services provided by improved forms of pasture and livestock management would need to be translated into tangible incentives for the farmer, and then would have an impact on adoption behaviour. These decision support models would be disseminated through active dialogue and workshops with policy makers.

Other Incentives. Other incentives to farmers, such as fair trade agreements and certification of livestock products resulting from converting grass monocultures and silvopastures, can also help to promote the expansion of these alternatives throughout Latin America and would be promoted by the project. A growing market for environmentally-friendly food products is setting the stage for farmers to develop agricultural systems compatible with nature conservation. Helping local governments and NGOs to define the minimum requirements for certification is a policy issue of the utmost importance.

Another line of action aims to identify economic incentives for silvopastoral systems in Latin America, including the promotion of agro-ecotourism within farms adopting them. The potential of these systems to attract and maintain a diverse array of wildlife species can be an added value to the direct financial and social gains perceived by farmers. The example set by coffee-growers in the Central Andes of Colombia can be replicated in livestock grazing enterprises. Ranches with complex vegetation and a rich fauna may be a major tourist attraction that can increase the income of small farmers without compromising the productivity of the systems.

C: Project Description Summary

1. Project components: (see Annex 2 for a detailed description and Annex 3 for a detailed cost breakdown).

Table 2 Description of major project components.

Component	Sector	Total Incremental Costs (US$M)	Local Contribution and Other Donors (US$M)	GEF (US$M)	% of Total
Ecosystems enhancement and Capacity building. *Ecosystem Enhancement.* To establish demonstration sites totalling at least 3,500 ha improved silvopastoral systems, which would provide a variety on ecological services in an area of 35,000 ha. *Capacity building:* (i) Technically assist stakeholders, strengthen local organisations and (ii) produce and disseminate communications on integrated ecosystem management and in the implementation of sustainable livestock production systems.	Environmental Management and Agro-Biodiversity	4.5	3.2	1.3	51
Monitoring and Evaluation of Ecological Services. Obtain improved information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits.	Environmental Management and Agro-Biodiversity	0.95	0.2	0.75	11
Ecoservices Fund. Gain experience on beneficiaries response to incentives for farm's investments in biodiversity conservation and land use changes to produce global environmental benefits.	Environmental Economics	1.4	0.2	1.2	17
Policy formulation and Outreach. Prepare policy guidelines for sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms incentive regimes, land use and land tenure procedures and environmental services.	Environmental Economics	0.75	0.1	0.65	9
Project management. Strengthen the administrative and organisation of the collaborating institutions	Administration	0.8	0.2	0.6	9
	Total	**8.4**	**3.9**	**4.5**	**100**

2. Key Policy And Institutional Reforms Supported By The Project:

Livestock production in the Latin American region has suffered over the last decades from depressed world market prices. Only in recent years have they picked up. Low prices provided little incentives for intensification

of livestock, in particular ruminant production. The main avenue for expanding livestock production and meeting domestic food needs was expansion of livestock number by claiming additional land, i.e. expanding pastures into forested land. This expansion into native forest was largely driven by large-scale ranching, encouraged by perverse export and credit subsidies, land titling and price policies. Most of those policies have now been phased out, although insecurity of land tenure (in particular of forest land) and price policies on inputs and outputs, still play a role. There is now increasing evidence that most of the newly claimed land is driven by smallholders, who attempt to escape from resource pressure elsewhere. Moreover, pricing of some inputs (pesticides, fertilisers, energy) still favour high input levels, and do not favour silvopastoral systems with a much lower dependence on outside chemical and fossil inputs.

Over the last decade, a great deal of technologies have been developed that intensify cattle production, increase the output of milk and meat per unit of land, in environmentally friendly systems, which can spare land otherwise threatened by deforestation. Enabling policies would need to enhance security of land tenure, establish appropriate pricing, in particular of inputs and outputs, develop mechanisms for benefit sharing for bio-diversity, and most specifically compensation global environmental benefits. This could bring about a change in the behavior of ranchers and rural communities from continuing deforestation and land degradation towards the development of more intensive production systems, reduce the pressure on the forest and contribute to the global environment through the conservation of bio-diversity and the reduction in the emission of greenhouse gasses. The project would develop guidelines and tools for supporting policy makers by developing a training curriculum that emphasizes the importance of appropriate land tenure, pricing policies and cost and benefit sharing arrangements for ecological services and of changing ranchers behavior by improving public awareness at the national, provincial and local levels.

3. Benefits And Target Population:

Financial and Social Benefits

An initial assessment of the financial benefits is provided in section E1/2. There is a wide variation of data according to local conditions and sources quoted. In summary, the increase in bio-mass varies from 2.7 to 6.7 ton/ha/year; carbon sequestered varies from 2 to 10 ton/ha/year and investment costs for the establishment of silvopastures from US $200 to 730 per ha.

Murgueitio (2000) shows that the inputs required for silvopastures are less than the improved and conventional pastures. There is a 100% reduction on herbicide and pesticides usage, 20%/ha/year reduction on water use for irrigation usage and a reduction on nitrogen fertilisation of 400 kg urea/ha/year. This leads to an overall estimate of the financial benefits of $ 40 per ha. However, further analysis under the individual conditions of each site are needed and will be carried out during the appraisal. Socially the technology is much more labour intensive, and therefore will contribute to reducing the structural unemployment in many rural areas of Latin America. For example, on a typical farm of 70 ha, labour requirement from a 5 ha plot of silvopastures would go up from 2.5 to 3.5 man year.

Target Population

The direct beneficiaries include small- and medium-sized landowners (10-70 hectares farms), depending mostly on livestock and food crop production, with an average annual income from the farm of about US $ 3,000 More detailed socio-economic analysis is provided in Annex 8 and will be deepened as part of the project preparation. In line with the Bank strategy in Nicaragua, a particular focus would be on smallholders. The beneficiaries include also rural communities and non-government organizations involved in the project. The environmental benefits related to biodiversity conservation and reduction of greenhouse gases likewise accrue to the international community. Finally the further development of the methodologies to measure carbon sequestration, bio-diversity, and water quality and lessons learned on the cost-benefits of silvopastoral systems, and the mechanisms of payment for ecological services would directly benefit a number of initiatives in other countries in Latin America. Specifically, projects incorporating environmental service payments for forest conservation are being prepared or implemented by the World Bank in four other countries in Latin America (El Salvador, Guatemala, and Ecuador). Furthermore, the project would play a key role, through its link with the

Virtual Center of the Livestock Environment and Development (LEAD) initiative and through the highly respected regional research institute Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) (Annex 5), in disseminating these experiences world wide and potentially make it a part of the global discussion on the complementarity of agricultural production and eco-systems enhancement.

4. Institutional And Implementation Arrangements:

Implementation period: 5 years

Institutional Arrangements

Executing Agencies:

- Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Costa Rica, with subcontracts to
  - Centre For Research on Sustainable Agricultural Production Systems (CIPAV),
  - Nitlapán, Nicaragua

Colombia: The Centre For Research on Sustainable Agricultural Production Systems (CIPAV) is a NGO recognized for its scientific and technological excellence, made up by a network of agricultural enterprises and a group of small farmer families, associated with qualified researchers who provide their knowledge for the solution of concrete problems. It is permanently in contact with several groups, research centers, institutions and companies that encourage rural sustainable development throughout Colombia and various countries in Latin America, Asia, Africa, Europe and the United States. CIPAV's institutional mission is to contribute to sustainable development through research, training, and communication related to production systems appropriate for tropical agroecosystems. CIPAV has legal entity.

Costa Rica: The Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) is an international, non-profit civil association, that conducts research, education and outreach activities in agricultural sciences, forest management and biodiversity conservation, agroforestry systems and watersheds, socioeconomics and related subjects on natural resources management, It operates throughout Latin America, with an emphasis on Central America and the Caribbean. CATIE's mission is to alleviate poverty and increase human well-being by applying research and teaching towards the conservation and sustainable use of natural resources in Tropical America. Due to its active research, outreach and training program and its close relations to many research and academic institutions, CATIE is a leader of natural resource management and conservation in the region. CATIE has legal entity.

Nicaragua: Nitlapán (which means, "*time to sow*" in the indigenous Nahuatl language), is the Institute of Research and Development of the University of Central America (UCA), a Jesuit university located in Managua, Nicaragua. Over the past decade, Nitlapán has developed an innovative, multi faceted approach to reactivating the economy and society of Nicaragua. Its focus is rural economic development. Its principle tools are micro-finance, applied research, and development. Nitlapán has developed innovative approaches to diagnose and address the vicious cycle of under-capitalization, environmental degradation and lack of technical information in rural areas. In the process, is succeeding in integrating practical strategies of environmental recovery in its development programs. Nitlapán is highly regarded both within Nicaragua and abroad. Its reputation as a professional, ethical, apolitical and non-ideological organization has won respect and trust from current and former administrations and credibility along the political spectrum. Grant and investments have come from donors in the United States and Europe, including the MacArthur and Ford foundations, Oxfam and Intermon. Nitlapán plays a critical role in helping rural families get back on their feet as well as in institutionalizing a rural finance system that incorporates modern, ecologically sensitive practices. Nitlapan has legal entity.

Project partners and cofinancers:

The LEAD (Livestock, Environment And Development) Initiative is an inter-institutional initiative with the secretariat in FAO. This initiative is supported by the World Bank (WB), the European Union (EU), the Ministère de la Cooperation (France), German Federal Ministry for Economic Cooperation and Development via GTZ

(Germany), the Department for International Development (United Kingdom), the US Agency for International Development (USA), the Danish Agency for International Development Agency (DANIDA), the Swiss Agency for Development and Cooperation (Switzerland), the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), The International Livestock Research Institute (ILRI) and FAO. The work of the initiative targets at the protection and enhancement of natural resources as affected by livestock production and processing, while alleviating poverty. LEAD has identified, at a global scale, the consequences of increased pressure on grazing and mixed farming systems and the dangers of the shift to industrial modes of production, as the main areas for its support. It highlights the close interaction between government policies and the environmental impact of livestock production, and shows the large number of technologies, which are available to mitigate the negative effects in all different production modes, provided the appropriate policy framework is in place.

American Bird Conservancy (ABC) is a not-for-profit organization dedicated to the conservation of wild birds and their habitats in the Americas. The fundamental role of ABC is to build coalitions of conservation groups, scientists, and members of the public, to tackle key bird priorities using the best resources available. ABC has offices in Washington D.C. and The Plains, Virginia, and staff in Colorado, Montana, and Oregon. ABC is a leader in Partners in Flight (PIF). PIF is a multinational initiative to integrate existing bird conservation needs and programs into a single, comprehensive plan for protecting all birds in North America. A diverse array of more than 200 non-profits, government agencies, forest product companies, colleges, and universities participate in PIF. ABC's Important Bird Areas program is a central aspect of PIF and involves hundreds of volunteers and other conservation groups in a nation-wide effort to identify and enhance protection for the most important sites for bird conservation in the U.S. ABC's international program in Latin America aims at demonstrating how current rates of habitat destruction can be reduced while promoting the development of productive practices in rural areas that are compatible with the maintenance of habitat diversity to sustain biodiversity.

Implementation Arrangements

The inter-institutional co-operation and organisation for the project is arranged as follows:

- It is proposed that CATIE would be the central implementing agency for the project, directly responsible for the Costa Rica site, and subcontracting NITLAPAN and CIPAV for the implementation of the project sites in Nicaragua and Colombia respectively. CATIE would also act as the regional organisation for certification of land use change. Under the supervision of CATIE, each agency would be responsible for local organisation, exchange with the farmers and the management of the funds. Other local organisations would be associated to the project for the development of methodologies and dissemination of the results.
- LEAD provides support for the consultation and dissemination of results and scientific backstopping. It also provides technical and financial assistance.
- ABC provides regional technical assistance for the biodiversity component and regional organisation for certification of biodiversity. ABC would provide a common and consistent methodology for the monitoring and certification of birds and biodiversity in the three countries.
- Steering Committee, composed by representatives of the executing agencies, the GEF focal points in each country (as representative of the respective Ministries of the Environment), possibly a representative of the Ministries of Agriculture of each country, ABC and LEAD would ensure the co-ordination of the activities in the three sites, and the compatibility of data and analyses, and
- World Bank would provide the technical and financial supervision of the project.

The implementation plan is illustrated in table 3.

Table 3. Implementation schedule of the Project.

PROJECT ACTIVITIES	PROJECT-MONTHS						
	0	10	20	30	40	50	60
1. *Ecosystems Enhancement and Capacity building* Teach and technically assist stakeholders, strengthen local organisations and produce communications on integrated ecosystem management and in the implementation of sustainable livestock production systems.	✓				✓		
2. *Monitoring Environmental Services:* Obtain improved information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits.	✓						✓
3. *Eco-services Trust Fund*: Gain experience on benefit sharing mechanisms at farm and community level and beneficiaries response to incentives for land use changes and biodiversity conservation to produce global environmental benefits.	✓						✓
4. *Policy formulation and decision support:* Assemble policy guidelines for sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use and environmental services.					✓		✓
5. *Project Management.*	✓						✓

Financial Management:

Financial Management Systems

CATIE would establish and maintain an adequate financial management system, compatible with Project Management Reporting (PMR) as required by the Bank under the Loan Administration Change Initiative (LACI). The financial management system would include internal control systems, reliable records and report of project assets, accounting, financial reporting, reconciliation of the individual records of the implementing agencies with the individual Special Account financial statements, and auditing systems—to ensure the provision of accurate and timely information to the World Bank regarding project resources and expenditures, in accordance with: (i) the Financial Accounting, Reporting, and Auditing Handbook (World Bank, 1995); (ii) the Bank's Operational Policy (OP) and Band Procedure (BP) 10.02 dated July 1996; and (iii) the revised Bank financial management standards to comply with OP and BP 10.02, dated August 1997. As part of project preparation, a World Bank financial management consultant would carry out a financial management assessment.

Progress Reporting

CATIE would produce Project Management Reports (PMRs) on a six-monthly basis, on the basis of its own work and the six-monthly reports of CIPAV and Nitlapan. These reports would be prepared 45 days after the end of each semester. In addition, annual financial statements (to be included in the audit report) would be required. The fiscal year of the project would be from January 1 to December 31.

Annual Audits

In addition to submission of six-monthly reports, CATIE would contract an independent public accounting firm, prior to the beginning of the fiscal year to be audited. The auditors should be hired under a multi-year contract, according to terms of reference acceptable to the Bank, for the performance of annual project audits. The auditors

would conduct interim audits through each year of project implementation. A consolidated audited report for all project components would be submitted to the Bank within 120 days of the close of the project's financial year. The terms of reference and the proposed short list of public accounting firms have been submitted to the Bank, and the selected firm is to be hired within 30 days of project effectiveness.

Special Account

The Global Environment Facility grant funds would be disbursed into separate Special Accounts, in US Dollars, at a commercial banks, that would administer the funds for CATIE. Under the responsibility of CATIE, special accounts would be established by CIPAV and Nitlapan. The three banks selected should meet conditions acceptable to the Bank (e.g. providing a "comfort letter" acceptable to the Bank). The Eco-Services fund would be administered by commercial banks in a *fidecomisso*. The operational details would be specified in a Special Operational Manual for the Eco-Services Fund which should be ready before effectiveness.

Disbursements

CATIE, would be responsible for preparing withdrawal applications and the related SOEs, or PMRs, as applicable. CIPAV and Nitlapan would present SOEs or PMR to CATIE If, by project effectiveness, CATIE would not have implemented a financial management system with PMR capabilities, but have a system, which meets minimum Bank requirements, the traditional disbursement mechanisms (Statement of Expenditures, SOEs) would be used for the first two quarters of the project implementation. After the second quarter, or earlier if CATIE requests, disbursement requests would be PMR based.

The disbursements for the payment for ecological services and establishment of silvopastoral systems (Eco-Services Fund) would be detailed in the Special Operational Manual, which would be ready by project effectiveness. As described in section 3 page the Fund would finance the performance grants for ecological services and for changes in land use. CATIE would be the certifying agency for the changes in land use, whereas ABC would be the certifying agency for the biodiversity.

Project Monitoring and Evaluation:

CATIE would have a co-ordinating role and would monitor project objectives, outcomes, and activities using logframe indicators presented in Annex 1. In each country the local project co-ordinator and financial project manager would be responsible for constant monitoring and evaluation to determine the success of project administration.. Selected programs of stakeholder consultation, training, and capacity building would include evaluation sessions using instruments such as questionnaires, group evaluation forms, and open discussions. Special reports would be completed as necessary. The Steering Committee (LEAD, ABC, CATIE, CIPAV, NITLAPAN, Focal Points, representatives of the Ministry of Agriculture) of the project would meet at least once a year and would serve as an expert panel of advisors/evaluators. Monitoring results and conclusions reached as a result of evaluation reports would be used to recommend and implement changes in project management and for future reference in the development of similar or related projects.

D: Project Rationale

The project would address one of the most important driving forces for land degradation in Latin America, by introducing a technology which has been adopted at individual farms, but has not yet been introduced at the level of larger areas, or watersheds. Its support for performance based incentives for a variety of environmental services is innovative, and could have relevance far beyond the particular eco-system and technology. Because of its demonstrative and innovative character, funding through GEF is the most rational approach. The rationale concerning key project features of project size, focal area and funding mechanism are provided below.

Project Alternatives Considered And Reasons For Rejection:

(1) *Medium Sized Grant.* The first alternative consisted in the development of a Medium Size Project (MSP). However, with the need to cover three countries, (see D. 5), and the need to carefully monitor the effect of the project on all components of the environment (carbon, bio-diversity and water quality), it was decided that the available funds from a MSP would be insufficient to support the holistic eco-systems approach as now proposed. A full GEF project is therefore proposed.

(2) *Government execution.* An alternative to the project design consisted of a project executed by the Government of Nicaragua, Costa Rica and Colombia. However, it was considered preferable that the executing agencies be independent of the central government budget, in view of the current financial difficulties and the difficulties associated with routing resources through the government budget. The Steering Committee would ensure that required involvement and "ownership" by Government agencies.

(3) *Regional vs. national coverage.* A project covering only one country was considered. However, it was decided to assign a strategic role to this initiative, requiring therefore that it deals with regional issues that could be representative of pasture /forest interface of the entire Latin America. Moreover, the current choice of three countries, would allow that a wide variety of eco-systems, degrees of degradations, and socio-economic conditions (population density, production intensification) are being covered, thereby enhancing the possibilities of extrapolating the results to a wide set of conditions in the region. Moreover, the three national implementing agencies, would compliment each other in skills, with CATIE 's unique skill in scientific monitoring of Carbon and Socio-economics), CIPAV and its specialized experience in silvopastoral systems for watershed management and water quality monitoring, and NITLAPAN and its experience in participatory approaches and technology transfer and credit. This would provide a strong synergy and cross support of one agency to the other two in its own specialized field.

(4) *Climate Change or Biodiversity-only as focal areas.* Consideration was also given to a simpler thematic focus restricted to climate change program (carbon sequestration) or to biodiversity. However, the nature of the project and the natural resources management issues related to the project really called shared synergies between the three GEF focal areas and land degradation. OP. 12 was chosen because it responded very well to stakeholders' interest in addressing holistically multiple convention objectives in accordance with national priorities.

(5) *Revolving Fund.* For the incentives to induce the development of more intensive silvopastoral systems, the establishment of a revolving fund and beneficiary repayment of the initial investment was considered. However:(a) financial calculations (Tables 5 and 6, and Annex 4) indicate that most likely these payments are needed to induce the required intensification, as the return to labor without the payment for the ecological service would be lower than the returns from traditional pasture and/or slash and burn technologies. A recognition of the global environmental benefits, in the form of a direct payment is needed to "tip the balance" from slash and burn to intensive silvopastoral systems; (b) the project would serve as a prototype to test behavior of farmers and ranchers to the eventual establishment of a fund, based on tradable emission rights, and introducing a repayment requirement of the incentives paid for the global ecological services would be contrary to this objective.

Major Related Projects Financed By The Bank And/Or Other Development Agencies:

Overall

The project is complementary with on-going World Bank-implemented projects targeted towards poverty alleviation, natural resources management, and biodiversity conservation within the Mesoamerican Biological Corridor, including the *Rural Poverty and Natural Resources* project and the *Atlantic Mesoamerican Biological Corridor* in Panama, the *Rural Municipalities* project and the *Atlantic Mesoamerican Corridor* in Nicaragua, the *Rural Land Management* project and the *Biodiversity in Priority Areas* project in Honduras, and the *Promotion of Biodiversity Conservation within Coffee Landscapes* project in El Salvador, among several other projects in the region. This project supports the continued evolution of projects supporting the sustainable use of biodiversity conservation in the region.

Regional Projects Focusing On Environmental Service Payments

There are several World Bank efforts in the field of *Payments for Environmental Services* in the Latin American and Caribbean region: The current GEF/World Bank work on environmental service payments is:

(1) In Guatemala, a natural resource management project, with a component on environmental services (with special emphasis on watershed protection) is under preparation.
(2) In El Salvador, the natural resource management project that was just identified also aims at using payment mechanisms to obtain environmental services -- in this instance, watershed protection (primarily for flood control/disaster prevention) and the creation of biodiversity corridors to link the country's protected areas (though in principle the mechanisms could be used for other purposes as well).
(3) In Costa Rica, the *Ecomarkets Project* currently starting implementation plans to use payments to obtain a variety of environmental services, including watershed protection for hydrological benefits and carbon sequestration. The Costa Rican government already has a program of payments for environmental services -- the *Environment Services Payment (ESP) program* -- under which landowners can receive payments for maintaining or replanting forest areas.
(4) In Colombia, the watershed protection component of the natural resource management project currently nearing the end of its implementation used a subsidy scheme to induce farmers to reforest, with the aim of generating hydrological benefits (securing water supplies to municipal water systems and other downstream water users). the payment scheme used by this project and a similar Inter-American Development Bank project became the subject of a great deal of controversy, concerning both the likelihood that land-use changes would be sustainable and that they would achieve the desired benefits.

Biodiversity And Sustainable Land Use

Colombia. *Natural Resources Management Program* (WB/3692-CO) is related to this project proposal through the following components: (i) analysing and strengthening regional environmental bodies, and (ii) sustainable management of the National Parks.

The WB/GEF project *Sustainable Use of Biodiversity in the Western Slope of the Serranía del Baudó* (MSP) is being implemented in the Chocó region, within operational programs 2 (Coastal, marine, and freshwater ecosystems) and 3 (Forest ecosystems) with Fundación Natura Colombia as executing agency. The objective of this MSP is the development of a strategy for the sustainable use of biodiversity in the western slope of the Serranía del Baudó and the marine resources of its coastal area in a joint effort between governmental institutions and civil society, designed to benefit local communities.

Four additional related WB/GEF projects are under preparation in other parts of Colombia:
(1) *Conservation of Biodiversity in the Sierra Nevada de Santa Marta*. Executing Agency: Fundación Prosierra Nevada de Santa Marta. The objective of this project is to conserve, restore and promote sustainable use of the mosaic of tropical ecosystems in the Sierra Nevada de Santa Marta (GEF-Council approval, December 1999).
(2) *Conservation and sustainable use of biodiversity in the Andes region*. Executing Agency: Instituto Von Humboldt. The project's development objective is to increase conservation, knowledge, and sustainable use of globally important bio diversity in the Colombian Andes. (GEF-Council approval, May 2000).
(3) *Conservation and Sustainable Development of the Mataven Forest* (MSP). Executing Agency: Etnollano. The objective of this MSP is to support the establishment and demarcation of indigenous territory as a strategy for natural resources conservation. It is working on the creation and management of the first "Indigenous National Park" as a strategy for conservation and sustainable use of biodiversity in the Mataven forest in the Amazon region. (Block A granted-Submitted for GEF Approval in November 2000)
(4) *Community Based Management for the Naya Conservation Corridor* (MSP). Executing Agency: Fundación Proselva. The objective of this project is to develop and implement a community-based biodiversity management and monitoring plan, endorsed by local communities and government, to be the

long term guide for future development in the Naya river basin of the Chocó region. (Block A granted)

The *Biodiversity Conversation Project of the Colombian Massif*, an UNDP/GEF sponsored project (RSP), focuses on the strengthening the protection of highly conserved montane forest and paramo vegetation, in the highland areas (2000-4000 meters above sea level), including the Cauca department.

These projects compliment each other both in focus and geographical areas, as shown in Annex 10 and the specific map in the Annex 11.

Nicaragua. Currently, the World Bank has four projects related to this proposal:

(1) The *Rural Municipalities Project* which aims to reduce rural poverty and improve natural resources management.
(2) The *Atlantic Biological Corridor Project* (GEF), which aims to promote the integrity of a biological corridor along the Atlantic slope of Nicaragua by ensuring the conservation and sustainable use of biological resources in this region.
(3) The *Sustainable Forestry Investment Promotion Project* which aims to improve local capacity and develop alternatives to address long term forestry issues in Nicaragua.
(4) The *Renewable Energy and Forest Conservation project: Sustainable Harvest and Processing of Coffee and Allspice* (GEF MSP) which aims to promote the use of renewable energy in the development of biodiversity-friendly agro-industrial process in rural Nicaragua.

Costa Rica. This project complements a number of ongoing and recently-completed GEF-financed activities in Costa Rica, including:

(1) The *National Biodiversity Strategy and Action Plan*;
(2) The GEF/World Bank/INBio *Biodiversity Resources Project*;
(3) The GEF/UNDP Medium-sized project in the *Talamanca-Caribe Biological Corridor Project*;
(4) The GEF/World Bank/CATIE *Sustainable Cacao* Medium-Sized Project.
(5) The UNDP/UNEP/GEF/CCAD/GTZ/DANIDA regional program to consolidate the Mesoamerican Biological Corridor (MBC).

While this project complements active projects within the region by utilizing some aspect of payment for environmental services, many of the projects focus on different technologies and production systems. This is the sole project within the GEF/World Bank portfolio wihich emphasizes rehabilitation of degraded ecosystems and the use of silvopastoral technologies. Second, this project focuses on multiple ecological services, while most other projects focus on one (i.e. biodiversity or climate change). Combined, this project would supplement existing operations with valuable lessons which are transferable to the rest of the Bank and GEF portfolio. There were relatively greater opportunities for complementarity and coordination with the Colombia GEF portfolio, and as such, a detailed analysis on how these difficulties are addressed is provided in Annex 10.

Table 4. NRM Bank and GEF projects in Colombia, Costa Rica and Nicaragua.

Sector issue	Project	Latest Supervision (Form 590) Ratings	
COLOMBIA		**Implementation Progress (IP)**	**Development Objective (DO)**
Natural Resources (LOAN)	Natural Resources Management (Loan No. 3692)	S	S
Rural Development (LIL)	Peasant Enterprise Zones for Peace Project/LIL (Loan No. 4363)	S	S
Environment and Biodiversity (GEF + LIL)	Conservation and Sustainable Use of Biodiversity in Sierra Nevada de Santa Marta (GEF grant and Bank LIL under preparation)	NA	NA
Environment and Biodiversity (MSP GEF)	Sustainable use of Biodiversity in the Western Slope of the Serrania del Baudo" (Medium-sized Project under implementation).	S	S
Environment and Biodiversity (MSP GEF)	Community Based Management for the Naya Conservation Corridor (Medium size GEF project under preparation)	NA	NA
Environment and Biodiversity (MSP GEF)	Conservation of Mataven Forest (Etnollano) (Medium size GEF project under preparation)	NA	NA
COSTA RICA			
Environment (GEF)	Biodiversity Resources Development (INBIO)	HS	HS
Environment (IDF)	Certified Tradable Offsets	HS	HS
Environment (GEF+ LOAN)	Ecomarkets		
Environment (GEF MSP)	Sustainable Cacao	NA	NA
NICARAGUA			
Biodiversity (GEF)	Atlantic Biological Corridor	S	S
Forestry (Credit)	Sustainable Forestry Investment Promotion	S	S
Climate Change (GEF MSP)	Renewable Energy and Forest Conservation: Coffee and Allspice	NA	NA
Decentralization and Environmental Management (LOAN)	PROTIERRA I	S	S
Decentralization and Environmental Management (LOAN)	PROTIERRA II	NA	NA

IP/DO Ratings: HS (Highly Satisfactory), S (Satisfactory), U (Unsatisfactory), HU (Highly Unsatisfactory) NA: Not available

3. Lessons Learned And Reflected In The Project Design:

Project execution should be entrusted to agile and efficient institutions. The project uses three well recognized and highly reputable NGOs in implementing this project, and not a public agency, to avoid bottlenecks in terms of capacity of implementation and budgetary authority. The implementation and administration responsibilities would be with the NGO's, and no funds would be channeled through the central government's budgetary system. However governments will be involved in the implementation as they are part of the project's Steering Committee.

Effective natural resources management requires an ecosystem approach. The project seeks to achieve multiple objectives that can not be obtained with a sectorial approach. The silvopastoral technology combines low external input use, and major changes in the vegetative cover, land use and stock management with farmer education and training, and therefore addresses the entire eco-system.

Effective management of silvopastoral systems require strong stakeholders participation. The establishment of silvopastoral systems would only work if there is social consensus, involvement and participation since the early stage of local stakeholders. Therefore the project seeks to work in a participatory fashion, with exchange programs between farmers. The participation strategies would accommodate local biophysical and socioeconomic particularities, depending on the region and zone. One of the most important lessons learned from activities associated with the projects within the Biological Corridor includes the importance of involving local populations and institutions (e.g., local government, community and sectoral organizations, NGOs) in project design and implementation in order to ensure long-term objectives. As such, the project includes technical assistance for local NGOs and associations to support ecosystems conservation activities carried out by small landowners, rural women's organizations and young people groups. Consultations have taken place to strengthen local participation in the project.

Eco-services concerns need to be incorporated to broader political and socio-economic frameworks. The project would assist in a major effort to incorporate environmental service (provided by these ecosystems) considerations into sectoral planning.

Better efficiency and effectiveness during execution require an adequate monitoring and evaluation system. The project would make efforts in the acquisition and expansion of the knowledge base and development of methodologies for monitoring and to construct appropriate indicators.

Indications Of Borrower Commitment And Ownership:

The central governments of the three countries concerned have shown a high level of commitment in their endorsement of the project. This was achieved through a close involvement of the GEF focal points in an early stage of the project identification (see below). The three executing agencies have committed their support in a number of ways: participation in all preparation missions for the project, dedication of staff to prepare and coordinate all aspects of the project, identification of the project as their priority, co-financing of the project. The countries endorsed the project in : Colombia, Ministerio del Medio Ambiente, MMA: November 22, 2000; Costa Rica, FUNDECOOPERACION para el Desarrollo Sostenible: January 25, 2001 and Nicaragua, Ministerio del Ambiente y los Recursos Naturales MARENA: November 30, 2000.

Value Added Of Bank Support In This Project:

As an implementing agency of the GEF, and a committed lender in the environment sector, the World Bank has an active GEF portfolio in Latin America and the Caribbean. For this particular project, the Bank can add value in several aspects:

First, it brings to the proposed project the ability to serve as a source of knowledge for silvopastoral programs, regionally and world wide and as a catalyst for protecting ecosystems throughout Central America. For example, the project is likely to be directly relevant to the Mesoamerican Biological Corridor (MBC) initiative, spearheaded in part by the World Bank. This project is supporting actions on the part of national ministries, non-governmental organizations, the private sector, local groups, and indigenous communities for the conservation and sustainable use of biological diversity. Second, beyond experience in the natural resource management sector, the World Bank also brings to this project its experience in social sectors, with farmers and indigenous communities. Third, through its direct involvement in the Livestock and Environment Initiative, the Bank has a significant body of knowledge on the driving forces in the livestock-deforestation dynamics and brings in the global experience of different LEAD partners (i.e. FAO, CIRAD, DANIDA, DFID, French Cooperation Ministery, GTZ, IFAD, ILRI, USAID and World Bank) on agriculture, agro-biodiversity, livestock policy issues, natural resources management, etc. Finally, the Bank can contribute to this project with its initial experience in payment for ecological services. Specifically in Costa Rica, the Bank has been supporting the Ecomarkets Project

and a number of other GEF biodiversity projects. The Bank also brings the experience of the Prototype Carbon Fund.

The value added of global support with GEF resources lies in the global significance of the ecosystems, represented in the MBC (that spans from Mexico to Colombia) and the need to gain experience in the mechanisms of funding for ecological services and biodiversity conservation outside of national parks and biological reserves. GEF resources are critical for supporting the global incremental costs and for providing a platform for strengthening regional coordination in the monitoring of the environmental services provided by silvopastoral systems.

E: Summary Project Analysis: (detailed assessments are in the project file, see Annex 11)

Fiscal Impact

There is no government counterpart contribution to the GEF resources, the counterpart contribution is entirely funded by the implementing agencies and the LEAD initiative. The project has therefore no incur any extra government expenditure. However since farm sales are subject to 10 % sales tax, there would a net positive fiscal impact.

Financial Analysis (see Annex 4)

Two preliminary analyses have been carried out: details are provided in Annex 4b.

(a) *Cash flow and financial rate of return:* a preliminary analysis of the expected cash flow and financial rate of return was carried out for an average smallholder farm (70 ha) to assess the economic and financial viability of the silvopastoral technology based. The analysis covers whole farm cash flow and is based on the assumption on silvopastoral improvement of a 5 ha. plot, and calculated at commercial rates and prices.

Table 5. Key cost/benefit parameters in introducing a silvopastoral technology on a 70 ha farm.

Item		Item	
Incremental investments	US $ 7250	Incremental benefit farm/year	US $ 1321
Average incremental milk yield kg/farm/year	21330	Net present value (15 years, 5% discount rate)	US $ 1396
Incremental animal sales/year	US $ 5300	Rate of Return	0.08
Incremental labor requirements /farm/year	1.3 man year		

Alternative scenarios would be studied during the appraisal process. The preliminary analysis also points to significant social benefits of employment generation, as the labor requirement increases from 2.4 to 3.5 person/year. This might be one of the major incentives for smallholders where the opportunity costs of labor are very low, and where the additional labor can be supplied by the family. In that case the additional family income is about US $ 4,000 per year.

(b) *Cost effectiveness analysis:* given the difficulty in quantifying and valuing the environmental services generated by the proposed project, a financial and economic cost-effectiveness analysis was carried out. In this analysis, the discounted costs of the program are compared with the discounted costs of alternative investments, which would lead to similar environmental benefits. This case is a reforested previously degraded pasture with native species, for which the land would be purchased. It is assumed that there would be a reduced bio-diversity effect of the cultivated forest but increased carbon-sequestration. This preliminary analysis is shown in table 6 for a 70 ha forest plantation.. Results show a cost of about US $ 8.5 per ton of carbon sequestrated by the plantation forest.

Table 6: Key cost effectiveness parameters of alternative investments: the case of reconverting degraded pastures into plantation forest with native species (70 ha).

Item		Item	
Land compensation	US $ 17,500	Total Carbon sequestered (ton)	9,100
Establishment costs	US $ 41,040	Costs per ton of Carbon sequestered	$ 8.48
Average annual maintenance costs	US $ 7,420		
Average time to reach maturity	27 years		

2. Economic: (supported by Annex 4)

Incremental Costs
To calculate the incremental costs of the project, an estimate of the baseline expenditure was made to establish the current and planned amount of funding for sustainable use of natural resources in the selected sites in Nicaragua, Costa Rica, Colombia region as well as for national level planning, during the life of the project. The difference between the cost of the baseline scenario (US$ 9.7 million) and the cost of the GEF alternative (US$ 18.1 million) is estimated at US$ 8.4 million. This represents the incremental cost of achieving global environmental benefits through establishing new silvopastoral systems, monitoring environmental benefits, establishing the Eco-Services Fund, strengthening policy and legal frameworks for natural resources, and increasing project management capacity. LEAD, ABC and the local organisations have committed to mobilising US$ 1.0 million toward the GEF alternative; these would cover monitoring of biodiversity and carbon sequestration, and strengthening the policy framework, staff redeployed to this project. Beneficiary contribution would be US $ 2.9 million. The GEF grant contribution would be US$ 4.5 million (see Annex 4 for the detailed Incremental Cost Analysis).

Benefits achieved by the baseline will be mainly at the local level and will include: improved production, increased information on production systems, further development of environmental impact monitoring systems, stakeholder training and increased awareness of environmental management issues. The baseline scenario does not provide technical or financial support for activities leading to intensification of production objectives that provide additional environmental services by supporting improved silvopastoral systems. The scope of the baseline is, thus limited and would not permit the design or implementation of a comprehensive integrated ecosystem strategy.

Benefits achieved by the alternative would result in changes in ecosystem and natural resource management patterns and in the generation of global benefits, particularly by developing alternatives to increase carbon sequestration, biodiversity conservation, and water quality of global value. The project could potentially increase the likelihood of survival for threatened or endangered species, protect endemic species habitat, promote restoration of biodiversity, improve water quality and watershed management and contribute to the reduction of emissions and in turn increase carbon sequestration. The emphasis on intensive local participation and the positive economic impacts of implementing silvopastoral technologies would produce a positive impact on the lilvelihood of farmers that would ensure long-term sustainability of project activities. Support to decision makers on policy formulation would allow the implementation of long-term strategies of biodiversity conservation, carbon sequestration and sustainable production at national, regional and global levels

3. Technical:

Several technical studies have been carried out by LEAD and the executing agencies. These are:

1. Technical, economic and management issues of carbon sequestration through pasture intensification.
2. Economic returns to carbon sequestration on pastures.
3. Intensification of pasture-cattle production in the tropics: carbon sequestration and other benefits.
4. Intensification of cattle production in Central America: Economic and environmental benefits

5. Fostering improved pasture/silvopastoral technologies for carbon sequestration: a strategy for developing economically sound and environmentally friendly cattle production systems in Costa Rica.
6. Carbon sequestration: an environmental opportunity for cattle production in Colombia.
7. Environmental and social adjustment of the cattle farming sector in Colombia.
8. Program for technical re-conversion of cattle ranching and carbon fixing in Nicaragua.
9. Management of trees in pastures for sustaining agricultural productivity and conserving regional biodiversity.
10. Wild birds in Latin America pasturelands
11. Biological diversity in cattle farming systems in Colombia.
12. Biological monitoring
13. Biological indicators of freshwater quality in cattle farming areas
14. Comparative financial analysis of silvopastoral systems
15. Institutional arrangements
16. Socio-economic assessment

The results of these studies have been used to assist in the design of the project.

4. Institutional:

see section C.4 above

5. Social (see Annex 8):

During 2000, a series of preliminary stakeholder analysis and rapid social surveys were made in each country and meetings were held with the farmers groups and community to discuss the problems and to evaluate the potential benefits of the project. Local partners also held a series of meetings with other reserach organizations and local researchers to get them involved in the development of the methodology and analysis of carbon sequestration and biodiversity. Consultation meetings were held with local environmental organisations and local governments and NGOs. The results of these meetings and consultations were included in the development of the project document, and are provided in Annex 8. A more in-depth analysis, in particular on the social profile of the project beneficiaries, and participatory consultations on the technologies are envisaged for the project in early 2001, as part of the project appraisal.

In sum, the following overall points have already tentatively been identified for the project:

- The selection of project zones is based on socio-economic data, institutional capacity, and other social criteria;
- The project would not have negative social impacts on the populations in the project areas;
- The project has a clearly defined participatory focus.
- The project's local activities are being designed through a participatory approach that aims at involving key stakeholders at a local level as main promoters of silvopastoral systems and environmental services.
- The project area does not include indigenous people.

Some preliminary results on the social organisation:

Colombia: The farmers in the region of Quindío and Cauca valley are members in five different farmer organisations. The *"Cooperativa de Ganaderos del Centro del Valle", "Cooperativa de Ganaderos del Quindío", Cooperativa de Ganaderos de Barragán y Santa Lucía", "Cooperativa de Ganaderos de Versalles"* and *"Cooperativa de Ganaderos de Risaralda"*. CIPAV works with these five organisations in other projects and activities and would carry on supporting them for this project.

Costa Rica: The livestock farmers in both areas identified for this study are well organised and have a keen interest in improving their production systems to benefit from increased productivity and environmental services. In Esparza, more than 65% of the farmers are registered with the *"Centro Cantonal Agrícola"* and La Fortuna farmers are registered with *"Dos Pinos*"; these organisation provides services and technical assistance to farmers. CATIE would work closely with this organisations.

Nicaragua: Farmers of the Matiguás – Río Blanco zone are small and medium size individual producers, with no formal organisation. The national farmer organisation "*Unión de Agricultores y Ganaderos*" has little influence in the region. A very strong non formal network of farmers for exchange and co-operation exists in the zone. NITLAPAN, has facilitated the transit from the informal co-operation network to established technical co-operation groups to promote the technical change and to respond to the demands and needs. These groups have become the local partners of NITLAPAN for hiring technical services: problem identification, areas for training, exchange among farmers, and, although still incipient, the development of initiatives for economic co-operation or local business more stable and more suitable for the demands of the community. NITLAPAN would continue supporting these groups in this project.

6. Environmental assessment: Environmental Category [] A [X] B [] C

The project would have highly beneficial impacts upon the environment, supporting improved natural resource management and biodiversity conservation. The project complies fully with the objectives of OP 4.36 Forestry, namely, "to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development."

There is no major adverse environmental impacts expected as a result of this project. Minor environmental impacts might be expected from some on-the-ground investments.

The Category B is designed to be entirely positive from an environmental standpoint, particularly by promoting conservation and sustainable use of biodiversity.

Main Environmental Benefits

Silvopastoral systems provide a deeply rooting, perennial vegetation which is persistently growing and which have a dense but uneven canopy. Silvopastoral systems are an alternative to prevalent cattle production in Latin America and have the potential to produce environmental services and improve people's livelihoods. The project focuses in the implementation of silvopastoral systems in 3500 ha (5 ha/farm), however once other parallel farm activities are in place (like biological corridors, live fences, land set aside for conservation, etc.), the environmental effects, such as the control of erosion, the increase in bio-diversity would scale up to the entire watershed level. It is estimated that these effects would scale up in a factor of ten to a total of 35000 ha.

- *Carbon sequestration:* Silvopastoral systems are capable of fixing significant amounts of carbon in the soil under the improved pastures and in the standing tree biomass (wood) Fisher et al. (1994), identified a substantial sink of carbon in pastures based on deep-rooted grasses which have been introduced in the South American savannahs. Research by CIPAV in Colombia has shown that there are higher carbon contents in soil under silvopastoral systems (Ramirez, 1997). Research conducted by CATIE (2000) in Panama and Costa Rica showed that silvopastoral systems can sequester more carbon in the soil (due to the increased growth of the pasture in the association with legume trees, they accumulate about 1.8 tons carbon per ha per year and in addition, an important fraction of the carbon is sequestered by trees in the form of wood.

- *Biodiversity conservation:* In recent years, ranchers have started to manage silvopastoral systems in order to increase the productivity of their lands while promoting the conservation of natural resources (Ibrahim & Schlonvoigt 1999). Silvopastoral systems have shown to play a major role in the survival of wildlife species by providing scarce resources and refuge (Harvey & Haber 1999); to have a higher propagation rate of native

forest plants under these scattered trees (Harvey & Haber 1999); to provide shade for grazing animals, wind screens, wood for fencing, fuel, food, and shelter for wild birds (Harvey & Haber 1999). Food availability for wild birds is high in silvopastoral systems, and the complex structure of the vegetation provides more adequate nesting substrate and better protection against predators than other agroecosystems. In addition, several authors have noted that both silvopastures and other agroforestry systems harbour a larger and more complex assemblage of invertebrates (50-90 percent) than monocultural pastures, which explains the diverse bird communities found within (Dennis et al., 1996). It has been pointed out that bird frugivores inhabiting secondary forests do not fly very far into abandoned pastures, which results in seed dispersal restricted to an area of 9-80 m surrounding scattered trees close to the forest edge. Recent expansion of secondary forests within ranches is likely to enhance forest seed dispersal into abandoned pastures, further increasing the connectivity between different elements of the forested landscape (wind screens, living fences, scattered trees, forest remnants, etc.).

- *Improve water infiltration and used for watershed management:* Water holding capacity increases with the presence of trees, which results in better water cycles, and consequently, in the conservation or improvement of water sources. Although it may even be better precipitation, area-wide, with the presence of forest cover, the presence of shrubs and trees shifts the rainwater flux from superficial runoff, with considerable soil erosion, to more water infiltration, greater soil retention and greater and more permanent springs and water courses.

- *Soil retention (prevention of landslides):* In hilly areas, trees have an additional protective role in the ecosystem, that of preventing landslides. Not only is the presence of trees essential for soil protection on slopes, but also the variety of species is important. Trees of different root depths are required for effective soil anchorage, in particular in those events of torrential rains accompanying tropical storms, which seem to become more frequent in recent years in many parts of the world.

- *Improvement of soil productivity:* increases nutrient re-cycling across a deep portion of the soil profile occupied by the root systems of a wide variety of plants associated of silvopastoral systems. Depending on the species of trees being used, and on local mil characteristics, trees extract water and nutrients from soil horizons inaccessible to grasses, and deposit them on the ground with the natural fall of foliage, twigs, and fruits. The biomass and amount of nutrients released by pruning the trees of the agroforestry systems varies depending on the kind of management in use. Nonetheless, it is known that up to 18 tons of dry matter/ha/year can be deposited on the ground and that the amount of nitrogen flowing through the system reaches values of up to 380 kg/ha/year in agroforestry settings (Alpizar et al.1983).

- *Economising fossil fuels:* Silvopastoral systems spare fossil fuels in various ways: a) Shrub and tree legumes fix atmospheric nitrogen and thus replace energetically (fossil fuel) costly inorganic nitrogen fertilisers that otherwise would be applied to pastures. b) Silvopastoral systems improve feed quality, quantity and seasonal distribution throughout the year, and consequently there is less need for supplementation with concentrates. In general terms, cereal-based concentrates coming from intensive production are very costly from the point of view of fossil fuel inputs. c) Life-fences and other trees present in forage banks and pastures, are sources of firewood for rural or urban use, directly replacing fossil fuel.

- *Reduce emissions:* Indirect reduction of the emission of greenhouse gases caused by deforestation and shifting agriculture.

- *Other benefits of silvopastoral systems:* The presence of trees potentially brings additional benefits to farms:
  - *Diversification of farm products:* Bee honey, fruits and wood (round wood, firewood & posts) are additional products that can be marketed when silvopastoral systems are established in farms. The economic value of these would vary depending on their demand and the distance from markets.
  - *Beautification of landscape:* A farm with trees is no only more beautiful but also more appealing to potential agro-tourists.
  - *Land rehabilitation*: Under certain circumstances, the present value of land can be substantially increased when trees have been planted, and this can be in itself, the main incentive for reforestation.

What are the main features of the Environmental Management Plan (EMP) and are they adequate?

The project is expected to have highly beneficial impacts upon the environment, supporting improved natural resources management and biodiversity conservation. Therefore, an EMP is not applicable in this situation.

Status of Environmental Assessment.

With eco-systems functioning as the main objective of the project, major attention is being paid to the environmental assessment of the project. The Environmental Assessment has been supported by the Livestock and Environment Toolbox of LEAD, which enables, through an interactive decision making process, to assess the impact of the different policy and technology options. The only possible negative environmental effect of the project could be the "moral hazard" problem of the proposed system of payments, which arguably could encourage more, rather than less deforestation. However, past experience in Costa Rica points to the contrary (Table 7). Moreover the financial analysis (Annex 4) shows the rather modest returns of the technology, even with a grant system. The procedures for the environmental impact assessments have been developed by CATIE for carbon sequestration, by ABC for bio-diversity and by CIPAV for water quality. They are described in Annex 7 and would be spelled out in detail the Operational Manual.

How have stakeholders been consulted at the stage of (a) environmental screening and (b) draft EA report on the environmental impacts and proposed environmental management plan? Describe mechanisms of consultation that were used and which groups were consulted?

The proposed project would support the Environmental Services provided by silvopastoral systems which benefits small- and medium-scale farmers and the rural poor in buffer zones of national parks and biological corridors throughout the countries. Stakeholders have been consulted throughout the project preparation .

7. Participatory approach:

Public Involvement During Preparation

This project is being prepared under a strong participatory approach. See Annex 8.

The different stakeholders have been actively involved. The project preparation planning process included a number of stakeholder activities that were carried out starting from 1999.

- In May 1999, LEAD, CATIE and Servicios Internacionales para el Desarrollo Empresarial (SIDE), organized a seminar in Costa Rica aimed at entrepreneurs and the scientific community. The seminar "Livestock Intensification in Central America: Environmental and Economical Benefits" focussed on sharing information and identify strategies and policies for the development of a sustainable livestock production including the market of environmental services.

- On March 13, 2000, a workshop was organized in Plains VA, USA on Bird Conservation In Livestock Grazing Systems. This workshop, which included livestock grazing technicians and ranchers with experience in silvopastoral systems, and biologists with experience in community ecology, confirmed the feasibility of changing extensive grazing systems into alternative silvopastures, and provided the ecological basis for establishing a monitoring framework.

Two workshops were held to specifically elaborate the project documentation. The first, to develop the concepts was held in workshop in Costa Rica from July 10-14, 2000. This involved the GEF focal points and the proposed implementing agencies of the three countries selected for this project (NITLAPAN, CATIE and CIPAV), FAO/LEAD and WB staff, and a representative of the American Bird Conservancy (ABC). In a participatory fashion, details on the project were discussed and agreed upon, including the environmental impacts of the proposed technology, criteria for selection of the sites,

methodologies for measuring and certifying the two ecological services, socio economic evaluation, criteria and payment levels for the two main ecological services, funding of the initial on-farm investments, administration of the project, management of the Eco-Services Trust Fund and detailed budgets and timetable. The second, held in Rome from November 13-15, 2000 with the implementing agencies and the partners (LEAD, ABC), assessed requirements in the light of the shift from a medium to a regular size project, revised implementation arrangements, finalized the budgets and integrated the analysis of water quality in the project.

- During the year 2000 preliminary stakeholder assessments were made in each country and meetings were held with the farmers groups and communities to discuss the issue of land degradation and evaluate the potential benefits of the project. Local partners also held a series of meetings with other research organizations and local researchers to get them involved in the development of the methodology and analysis of carbon sequestration and biodiversity. Consultation meetings were held with local environmental organizations and local governments and NGO's. The results of these meetings and consultations were included in the development of this project appraisal document.

- Further stakeholder assessments would be carried out in the three project sites as part of the World Bank appraisal process (Annex 8).

Public Involvement During Implementation

Public involvement throughout the project is ensured by stakeholder participation, information dissemination and consultation. The executing agencies would be responsible for ensuring public involvement, dissemination and consultation in each country. The regional and global information dissemination and consultation would be the responsibility of LEAD's Spanish Speaking Platform and the Virtual Research and Development Centre.

Stakeholder participation: The project will be implemented in close consultation with all stakeholders. The participation strategy includes workshops and meetings at different stages of the project, with the local farmer's organisations, agricultural and environmental scientists and government environmental organisations. At early stages of the project these workshops would be orientated to involve community participation and to increase environmental awareness Further into implementation, local institutions in collaboration with farmer organisations, would hold regular meetings to evaluate the environmental and socio-economic impacts of the project. A series of training courses for farmers would also be carried out locally to introduce farmers to the new production technologies and research methodologies.

Regional Consultation:

During implementation, a regional workshop with all stakeholders and beneficiaries would be organised once a year to exchange information and experiences among those involved in the field work. Each research organisation should host a workshop for a total of three workshops during the project's cycle. An open consultation would be carried out by the means of an electronic conference on carbon sequestration by the LEAD's Virtual Research and Development Centre. Papers from leading scientists on carbon sequestration research would be invited to cover the scientific, environmental and socio economical aspects of the project. This consultation would be carried out in February 2001. For transparency in the project proposal, the LEAD's Virtual Research and Development Centre would provide the means for electronic data sharing and public access to the project results in the Internet (WEB and FTP).

Information Dissemination: Information from this project would be widely available. The results would be published in a series of publications targeted to several audiences including: manuals for farmers, and peer-reviewed scientific journals; reports and extension materials for different end users, including policy makers. The LEAD's Spanish Speaking Platform would facilitate the information sharing through its network of institutions in the region. Together with the Virtual Research and Development Centre would provide the means for conventional and electronic publications and would incorporate the results of the project within the Livestock and Environment Toolbox (an electronic decision support tool for policy makers). LEAD would also include the results of this project within its "Livestock-Environment in the Policy Dialogue" program which aims to the creation of a core group of specialists to mainstream livestock and environment policies, the organisation of

training/workshops for policy makers and the participation in policy formulation missions in developing countries.

CATIE would contribute to the dissemination of the project's results with its active outreach and training programs and its close relations to many research and academic institutions in the region. The CATIE educational program began in Turrialba in 1946. Consequently, its postgraduate educational experience spans more than 50 years. CATIE's has Master and Doctorate programs and organises training events corresponding to three structures: courses workshops, seminars and technical meeting. Project findings would be incorporated into its educational programs.

8. Safeguard Policies.

Policy		Applicability
	Environmental Assessment (OD 4.01)	No
	Natural Habitats (OP/BP/GP 4.04)	X
	Forestry (OP 4.36)	No
	Pest Management (OP 4.09)	No
	Cultural Property (OPN 11.03)	No
	Indigenous Peoples (OD 4.20)	No
	Involuntary Resettlement (OP 4.30)	No
	Safety of Dams (OP 4.37)	No
	Projects on International Waterways (OP 7.50)	No
	Projects in Disputed Areas (OP 7.60)	No

F: Sustainability and Risks

Sustainability:

The rapidly progressing degradation of conventional pastures, combined with the innovative character of the technology, and the highly skilled institutions such as CATIE and LEAD to disseminate the findings throughout the region and beyond, would be strong driving forces in the further dissemination of the technology and provide a solid foundation for long-term sustainability of project activities and outcomes. The pilot and innovative character of this operation inevitably implies that some sustainability aspects would need to be assessed, first during the appraisal, but more importantly during the implementation of the project. This is implied in the pilot nature of the project design. Individual sustainability aspects are provided below:

- *Technical sustainability*: The close participation of national and international experts and consultants in the different areas of the project, especially in silvopastoral systems would ensure state of the art technical design, resulting in optimal resource conservation and sustainable use. Experience so far, clearly indicates that silvopastures, once established, will be sustainable for at least 20 years and continue providing the local and global environmental impacts.

- *Environmental sustainability:* Research on silvopastoral systems indicates that Carbon will continue to be sequestered in the soil and biomass as long as the systems are in place. Moreover the silvopastoral systems will carry on providing other environmental services such as providing habitats for animal species, biological corridors, conservation of water and soil, etc.

- *Social sustainability:* Stakeholder involvement in all phases of project implementation along with training in biodiversity conservation and sustainable livestock production would be emphasised. The focus would be on increasing awareness of farmers and community on the relationship between global biodiversity conservation and carbon cycle and local sustainable production. International conservation efforts have shown that chances for long-term success increase relative to the amount of local community involvement in decision-making processes combined with the cultivation of a sense of stewardship. The five-year capacity building and

training component, the long-term presence of the local institutions and the strength of the farmer to farmer program would sustain the goals of the project in the long term and spread the technologies and environmental benefits to other regions.

- *Financial sustainability*: The increased animal productivity and higher financial returns would be important incentives to fully sustain the silvopastoral systems established under the project. The initial financial analysis shows moderate returns, which would be adequate for maintaining the silvopastoral systems, once initial costs are incurred. Moreover, it is highly likely that under conditions of high population pressure (and therefore land prices) and good markets, in particular for milk, the technology would be highly profitable. More analyses with different scenarios and under different conditions will be carried out during appraisal.

  While the recent conference in the Hague has deferred the decision on tradable payment systems for carbon sequestration, in particular those for land use and forestry, there is a widespread opinion, that ways to finance global environment services would be identified, and that the general principle of "the provider gets" will prevail. The Eco-Services fund represents a novel approach on this "provider-gets-principle" regarding payments for environmental services in ecosystems, linking changes in land use to global environmental benefits. Once experience is obtained with the funds operation, mechanisms to pay on a global scale (if required) could well be developed, further sustaining the results. Moreover, the project focus on policy and linkage with local organisations and local governments, would allow that during the duration of the project, funding strategies to insure the long-term success of this program, be investigated, developed, and applied.

- *Institutional sustainability:* The project would be implemented by NGO's with already a long term presence in the region. The increased technical capacity in these organisations, resulting from the project, and the building of links between them and other regional and global organisations through LEAD, would ensure that the institutions involved in the project would come out considerably strengthened in their operative capacity. and be better equipped to spread the technologies to other zones in their own countries and also at regional level.

Risk Assessment

Of the risks identified in the table below, there are two which require detailed explanation:

1. *The project incentives are not sufficient to motivate private landowners to change to a more sustainable production.*

This risk relates to the level of incentives offered by the Eco-Services Trust Fund. Reasonable incentives could generate behaviour changes on land use. Previous experiences suggest that:

- Financial returns in areas with high land prices, and the proximity of good markets in particular for milk, the financial returns are likely to be better;
- An incentive for investments leading to environmental services, even at modest levels, is likely to significantly change adoption behaviour.
- Net farm income would increase in comparison to the situation of incentives.
- Silvopastoral systems favour smaller farmers because of their higher labour requirements compared to conventional grazing. In regions, where the opportunity costs of labour are very low, the system might be in particular attractive for smallholder farmers.

2. Deforestation increases as a result of the carbon incentive on improved pastures and silvopastoral systems.

There is the risk that farmers response to the economic incentives, increases deforestation by clearing additional land for silvopastoral systems. This would be one of the key parameters to be tested in this project. Preliminary research data by CATIE in three pilot farms in Costa Rica show that pasture intensification leads to a decrease of unimproved pastures and a significant increase of secondary forest. This evidences that intensification leads to abandonment of conventional raising methods on native pastures and therefore reforestation.

Table 7. Land use changes, productivity and incremental carbon in livestock farms in Costa Rica

	Farm 1		Farm 2		Farm 3	
	1996	2000	1996	2000	1996	2000
Vegetal cover						
Native pasture %	49	24	42	23	35	18
Improved pasture %	2	16	1	12	0	10
Fodder bank %	0	2	0	0	0	0
Secondary forest %	1	10	2	10	1	8
Stocking rate	0.67	1.34	0.56	1.24	0.52	1.25
Milk, l/yr.	11,340	23,760	7,560	14,040	6,930	12,950
Incremental C, tons	1,970	3,210	1,720	2,740	1,524	2,345

Source: CATIE, 2000.

For the operationalisation of the compensation scheme it is important to address the "moral hazard" of farmers clearing forest for silvopastures to claim compensation for environmental services. This would be addressed by the following criteria to the establishment of the project.

- Limiting the eligibility of the project to zones where cattle production is one of the predominant economic activities and which are outside of the forest frontier.
- Humid or sub humid zones with degraded pastures.
- Presence of fragile and endangered ecosystems (corridors).
- Preference would be given to small or medium size farmers (in terms of capital).
- Silvopastoral systems should be already established in some farms.
- Presence of an organised group of farmers or community.
- Stakeholders' will to co-operate and participate in this project.

Monitoring of land vegetation cover would be carried out by the GIS unit in LEAD in collaboration with local partners.

Critical Risks: (reflecting assumptions in the fourth column of Annex 1) are provided in table 8

Table 8. Critical risks of the project.

Risk	Risk Rating	Risk Minimization Measure
From Outputs to Objective		
• Government commitment and legal framework for internalizing the cost of environmental services does not result.	M	As a demonstration project, the relevance of this risk is limited. Moreover, the project would target policy makers and decision makers so that they can take informed decisions.
• Regulations within Kyoto Protocol do not permit financing of carbon forestry programs.	M	The project would have contributed to a better understanding of the management of such programs. There is the assumption that payment systems for global environment services will be developed over the medium term. Moreover, the project focus on policy and linkage with local organisations and local governments would allow that, during the duration of the project, funding strategies to insure the long-term success of this program be investigated, developed, and applied.
• Environmental Service incentives are not sufficient to motivate private landowners to establish and manage silvopastoral ecosystems.	S	The project would take into consideration previous experience that suggests that: • An incentive for investments leading to environmental services, even at modest levels, is likely to significantly change adoption behaviour. • Net farm income would increase in comparison to the situation of incentives??. • Silvopastoral systems favour smaller farmers because of their higher labour requirements compared to conventional grazing. In situations where opportunities for alternative employment are limited, the overall returns for those small farmers are higher.
• Deforestation increases as a result of the environmental services payment (moral hazard)	M	• The analytical evidence is that intensification leads to abandonment of traditional raising methods on native pastures and therefore leads to reforestation. • Limiting the eligibility of the project to zones where cattle production is one of the predominant economic activity and outside of the forest frontier, and with the presence of degraded pastures. • Education and communication campaigns would be part of the project.

(Components to Outputs)		
• Production systems are not compatible with biodiversity	M	Careful attention will be paid to specific field site selection.
• Willingness of producers to participate is low	M	Project looks at alternative forms of income See above
• Field work is not possible due to security conditions	M	Focusing activities in area with low violence Project will target decision makers
• Decision makers are not interested in the information	S	Communication and Education Campaign to garnish long-term commitment.
• Political commitment to Environmental Services program is not maintained	M	LEAD policy work would show that it is in their interest. This will be conveyed to decision makers.
• Decision makers not interested in integrating environmental services into their sectorial plans	S	Outreach activities would focus the attention of decision makers on usefulness of the information
• Decision makers do not access and use information presented	M	Policy work and awareness building
• Sectoral agencies are not prepared to change	S	
• Project is not successfully implemented	M	Selection of very motivated Team and efficient and flexible structure

Risk Rating - H (High Risk), S (Substantial Risk), M (Modest Risk), N (Negligible or Low Risk)

Overall Risk Rating: **S**

Possible Controversial Aspects: No major controversial aspects.

G: Main Grant Conditions

	Conditions of Negotiation	Conditions of Effectiveness
M&E Plan	Advanced draft design	Completed
Procurement	* Satisfactory Procurement Plan (General Procurement Plan for the project life and detailed Plan for first year)	* Procurement plan approved. * TOR and selection of procurement officer prior review.
Financial Management, Audits	Project Management Information System design approved (including reports)	* TORs for fiduciary and accounting outsourcing approved by Bank * *Fideocommiso* arrangements with the respective local banks completed. * Project Management Information System and Reporting ready to operate * Auditors TORs approved
Grant Agreement		Signed
Operational Manuals	Draft Presented	Completed

H: Readiness for Implementation

[ ] 1. a) The engineering design documents for the first year's activities are complete and ready for the start of project implementation.
[X] 1. b) Not applicable.

[ ] 2. The procurement documents for the first year's activities are complete and ready for the start of project implementation.
[ ] 3. The Project Implementation Plan has been appraised and found to be realistic and of satisfactory quality.
[ ] 4. The following items are lacking and are discussed under loan conditions (Section G):
To be prepared later.

I: Compliance with Bank Policies

[X] 1. This project complies with all applicable Bank policies
[ ] 2. The following exceptions to Bank policies are recommended for approval. The project complies with all other applicable Bank policies.

[signature]
Team Leaders: Cornelis De Haan and Paola Agostini

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Sector Manager/Director: John Redwood

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Project Design Summary

Regional: Integrated Silvopastoral Approaches to Ecosystems management

Hierarchy of Objectives	Key Performance Indicators	Monitoring and Evaluation	Critical Assumptions
Sector-related CAS Goal: Strengthening the outward-orientation of the economy and supporting sustainable natural resource management.	Sector Objectives 1. Healthy and sustainable managed forest/pasture ecosystems.	Sector / Country Reports • ESW in the forestry/pasture sector • Satellite Images • LEAD Results	(from Goal to Bank Mission)
Project Development Objective: To obtain local environmental benefits through reduction in erosion and improvement in soil and water quality with increased production, income and employment in rural areas. To provide global environmental benefits, through improved biodiversity and carbon sequestration services. To gain an initial experience in the management of incentives required to produce global environmental benefits. To develop comprehensive guidelines for sector and environmental policies in terms of land use, environmental services and socio-economic development provided by the introduction of silvopastoral systems to rehabilitate degraded pastures.	Outcome / Impact Indicators • Sustainable silvopastoral systems established in three Latin American countries (35,000 ha). • Increased habitat for at least 50 bird species provided in each of the three countries. • Stable carbon sequestered in the soil and in commercial wood under silvopastoral systems (490,000 ton/year). • Increased water quality in three important watersheds in Latin America. • Improved resource monitoring methodologies developed for measuring carbon sequestration , biodiversity conservation, water quality in watersheds and socio economic aspects. • Increased awareness of the potential in environmental services provided by integrated ecosystem management and experience gained for future development of the integrated ecosystem management program. • Guidance for future funding, lessons for replication/best practice, and policy requirements for environmental services in livestock production defined.	Project Reports: • LEAD Annual Reports • ABC Annual Reports • CIPAV Annual Reports • CATIE Annual Reports • Nitlapan Annual Reports	(from Objective to Goal) • Macroeconomic stability • Sufficient political will exists for recognition and marketization of environmental services provided by silvopastoral ecosystems. • Violence, security conditions under control in the regions of the project

Outputs:	Output Indicators	Project Reports	(from Outputs To Objective)
1.1 Improved ecosystem functioning in at least 35,000 ha, providing improved ecological services in bio-diversity conservation, global climate change and water quality, and improved income.	1.1.1 About 3,500 ha silvopastoral systems, established, improving the eco-system in at least 35,000 ha to demonstrate the benefits of silvopastures for farming and biodiversity in three countries 1.1.2 Increased biodiversity conservation (at least 50 bird species/production system) land use change: #ha set aside for forest regeneration; #ha in forest conservation). 1.1.3 Increased carbon sequestration (about 500,000 tons carbon sequestered/ha/year). 1.1.4 Increased water quality in watersheds (reduction on Biochemical Oxygen Demand (BOD) and suspended total solids (mg/l). 1.1.5 Increased socio-economic impact (farm productivity: carrying capacity animal/ha, milk and protein production kg/ha/year; and farmers' wealth: family income US$/year, # of employment generated/productive activity/year).	• Technical Report • Farm Management Plan • Farms Registration into the Program • Satellite Images • CATIE and Lead reports • Survey of producers Annual report • External project audit • Semi annual supervision reports • Monthly disbursement reports	• Government commitment and legal framework for internalizing the cost of environmental services maintained. • Regulations within Kyoto Protocol permit financing of carbon sequestration in land use and forestry programs. • Environmental Service incentives are sufficient to motivate landowners to establish and sustainable manage silvopastoral ecosystems. • Deforestation will not increase due to payments for establishment of silvopastoral systems.
1.2. Stakeholders trained in integrated ecosystem management and in sustainable livestock production systems.	1.2.1 Local stakeholders trained in 3 countries (minimum 12.000 farmers). 1.2.3 Local organisation's capacity strengthen (12 organisations in 3 countries). 1.2.3 Regional awareness increased (affiliation with 2 regional networks).		
2. Measuring methodologies and quantitative information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits obtained.	2.1 Four methodologies to assess biodiversity, carbon sequestration, water quality on farm, watershed and community level and socio economic impact developed and tested . 2.2 Monitoring systems for biodiversity conservation,		

	carbon sequestration, water quality using biological indicators and socio-economic impact established (12 monitoring systems in 3 countries).		
3.Experience at community level and beneficiaries response to incentive systems for global environmental benefits obtained	3.1 Eco-Services Funds implemented in each of the target countries (institutional operation, fideicommiso, incentives systems arranged and legal contracts signed). 3.2 Certification of ecological services conferred (results of monitoring analysed at farm and landscape level, and environmental services paid to the farmers). 3.3 Farmers and community reaction to environmental services incentives and change of attitude and perception to local and global environment measured (investments US/ha on improved silvopastoral systems , changes on land use, #ha set aside for forest regeneration; #ha in forest conservation).		
4. Appropriate policy guidelines and training materials prepared and different level stakeholders trained in integrated ecosystem management and in sustainable livestock production systems.	4.1 Policy and technological requirements and guidelines, and appropriate decision support tools for environmental services in livestock production prepared 4.2 Specific recommendations for best ranching practices and land use that improve habitat heterogeneity to sustain higher biodiversity, and increase ranch yield disseminated among minimum 12,000 farmers, 12 NGO's and/or community-based groups, policy-makers and 2 regional networks. 4.3. Guidance for future funding, lessons for replication and for best practice developed.		
Project Components/Sub-components: 1.1 Ecosystems enhancement. To establish, at farm level, at least 3, 500 ha improved	Inputs: (budget for each component Million US$) 4.5	Project Reports:	(Components to Outputs) • Production systems compatible with biodiversity are

silvopastoral systems, which would provide a variety on ecological services in an area of 35,000 ha. 1.2. Capacity building: Teach and technically assist stakeholders, strengthen local organisations and produce communications on integrated ecosystem management and in the implementation of sustainable livestock production systems.			biodiversity are feasible. • Willingness of producers to participate • Field work possible due to security conditions
2 Monitoring Environmental Services: Obtain improved information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits.	0.95	• Technical reports • Articles Published • Statistical Reports	• Decision makers interested in the information
3. Incentives for Eco-Services (Eco-services Fund): Gain experience on beneficiaries response to incentives for farm's investments in biodiversity conservation and carbon sequestration to produce global environmental benefits.	1.4	• Contracts for Use of Eco-services Funds published	• Political commitment to program maintained
4. Policy formulation and decision support: Assemble policy guidelines for sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use and environmental services	0.75	• Policy guidelines officially published • Technical reports on environmental services	• Decision makers interested in integrating environmental services into their sectorial plans • Decision makers access and digest information presented • Sectoral agencies amenable to change • Government willing to participate
5. Project Management. Strengthen the administrative and organisation of the collaborating institutions.	0.8	• Annual and quarterly reports • Procurement records • Evaluation reports • Copies of contracts • Bank supervision reports • Field management reports	• Project successfully implemented

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Project Description

Overview of project activities

The main purpose of this innovative pilot project would be to assist local institutions in Nicaragua, Costa Rica and Colombia to remove the barriers that prevent the adoption of silvopastoral technologies which lead to integrated ecosystems management. The benefits of the project would be multiple: conservation and sustainable use of biological diversity, reduction of the greenhouse gasses affecting climate change, equitable participation of local community members in the economic benefits derived from the environmental services, and the establishment of the foundations of a comprehensive policy dialogue, that would ensure an integrated approach for lasting local and global benefits. To achieve this, the project would seek to deliver the following products:

- Trained stakeholders and strengthened local organisations, which are better informed on integrated ecosystem management and the implementation of sustainable livestock production systems, and significant areas with improved eco-systems functioning, as confirmed by soil, water and bio-diversity characteristics;

- Key scientific information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits;

- Information on the response at community and beneficiary level to incentive systems for biodiversity conservation and land use changes to produce global environmental benefits; and

- Policy guidelines to promote sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use and environmental services.

At the local level, the project would lead to higher income for farmers and increased self-determination through enhanced community participation in the project areas. The project would also contribute to increased environmental awareness among farmers and enhance the perception of communities to biodiversity, especially in relation to ranching. At regional and global levels, the project would lead the change to more sustainable production systems at the pasture forest interface, resulting in an increase in the provision of global environmental services in terms of: biodiversity conservation (providing habitats and biological corridors within the farms throughout silvopastoral systems and the conservation of forest on private land), and carbon sequestration (increasing carbon sequestration in soils and slowing deforestation on private land would mitigate greenhouse gas emissions).

For GEF, this pilot activity would provide guidance for future funding, the definition of policy requirements for environmental services (carbon sequestration, biodiversity and water quality on ago-ecosystems) in a major sector (livestock) for which operational programs have not yet been developed. The documentation of experience gained, good practices, and dissemination of lessons learned and know-how are also an integral outcome of the project. This would lead to greater awareness of the potential gains to be made in terms of environmental services provided by integrated ecosystem management.

The project would be realised over a period of 5 years. It is proposed to entrust overall implementation to CATIE in Costa Rica, with local implemention carried out by Nitlapán in Nicaragua, CATIE for the site in Costa Rica and CIPAV in Colombia. International partners are: ABC with headquarters in Washington D.C. and offices in The Plains, Virginia, and staff in Colorado, Montana, and Oregon; and LEAD with secretariat in FAO's headquarters.
The following components would be carried out by the project in order to achieve the above mentioned outcomes:

1) *Ecosystems Enhancement and Capacity Building*:

Technically assist stakeholders, strengthen local organisations and produce communications on integrated ecosystem management and support them in the implementation of sustainable livestock production systems. A series of activities at different levels would be carried out, targeted to a wide range of stakeholders. These include:

- Establishment at farm level, in a watershed context, of at least 3,500 ha improved silvopastoral systems, which would enhance ecosystem functioning and provide a variety on ecological services, through an improvement of the targeted watershed (reduction of erosion, creation of biological corridors). This would positively affect at least 35,000 ha, through the provision of the critical inputs of seeds, and other planting material, fencing material, equipment, etc.

- Community training programs for target groups: 60 workshops for 10 to 20 farmers for training and extension and 120 short workshops for planning, with follow up activities for groups of 6 - 8 farmers in each country. Additionally two one-day workshops would be carried out with local communities to increase awareness and perception of the importance of biodiversity.

- Horizontal transfer of knowledge among stakeholders: A total of 126 one-day farmer to farmer exchange field trips would be conducted in each country.

- Strengthening local organisations: In each country, nine workshops and seminars involving local organisations would be carried out for institutional capacity building in several areas including fair trade agreements, certification of livestock products, and agro-ecotourism.

- Education and extension material: A series of communication material including 6 booklets, 4 books and 1 technical manual would be produced in each country for training and information exchange to reinforce the community training programs. In addition, one video per country would be produced to disseminate the results of this pilot activity to a broader audience.

- Electronic conferences: Two electronic conferences aiming at a global audience of policy makers and researchers would be carried out and dissemination material and models would be made available on the Internet by LEAD's Virtual Research and Development Centre.

***2. Monitoring Environmental Services*:**

Obtain improved information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits. Monitoring biodiversity, using birds as indicators, carbon sequestration on the basis of soil organic matter, water quality using biological indicators and socio economic impacts of the intensified silvopastoral systems would be key elements of this component. A full description is provided under section l 6 (monitoring and evaluation plan). The development of the project would involve the following:

- Appointment of consultants, experts and local assistants for community training and transfer of technology in each country: 2 months expert consultant, 14 months national expert consultant, 17 months local assistant, in the case of Nicaragua and Costa Rica; and 14 months expert consultant and 17 months local assistant in the case of Colombia.

- Recruitment of extension workers and local assistants: on a country basis: 6 months expert on production systems, 17 months national expert and 84 months field assistant in Nicaragua and Costa Rica; and 24 months expert on silvopastoral systems and 84 months field assistant in Colombia.

- Development of the methodologies to monitor land use change, including carbon sequestration, and biodiversity, water quality and socio economic changes: acquisition of equipment for monitoring, technical monitoring and training to local assistants, setting up laboratory techniques for carbon soil and wood analysis, water analysis, establishment of participatory techniques for evaluation of socio economic impacts.

- Establishment of technical monitoring of bird species in each country: 72 months field assistant and 12 months consultant.

- Establishment of land use change, including carbon sequestration monitoring: in each country; 2 months consultant, 10 months national expert, 35 months local assistant in Nicaragua and Costa Rica and 2 months consultant, 7.6 months national expert, 35 months local assistant in Colombia.

- Establishment of technical monitoring of water quality using biological indicators (macro-invertebrates) in each country: 72 months field assistant and 12 months consultant.

3. *Eco-services Fund:*

Gain experience on beneficiaries response to incentives for farm's investments in biodiversity conservation and carbon sequestration to produce global environmental benefits. This activity consist of the Eco-Services Fund and the evaluation of the community responses to these incentives.

The Eco-Services Fund would provide incentives for land use changes that lead to biodiversity and carbon sequestration and would support small and medium livestock farms in the target sites in the three countries. The Fund for the Eco-Services would be managed by a financial institution (acceptable to the Bank) as a *Fideicomiso* in each of the countries concerned. Details on the functioning of the Fund would be provided in the Project Operational Manual and in the Fund Operational Manual. The Eco-Services Fund would supervised by the Steering Committee of the project.

- Provide Initial Investment Grants to cover the initial costs to change from the conventional extensive grazing system to silvopastoral systems: The Investment Grants would provide up to 50% of the establishment costs of silvopastoral systems and to a maximum of US$ 150 per ha and 5 ha per farm, for 200 farms in Nicaragua and Costa Rica and 50 farms in the Colombia. Additionally, in the case of Colombia where more costly silvopastoral systems and protein banks are needed, Investment Grants would be provided up to 45% of the establishment costs of intensive silvopastoral systems and to a maximum of US$ 450 per ha and 4 ha per farm for 3 farms; and up to 45% of the establishment costs of protein banks and to a maximum of US$ 731 per ha and 4 ha per farm for 2 farms.

- Provide Action Grants for expansion of silvopastoral systems. After the first year GEF would finance the inputs and services required for the establishment of additional areas of silvopastoral systems. The financing for these activities would be incremental each year and on a per ha basis, and would be based on an index composed of land use change, plant diversity and level of organic matter in the soil (as a proxy for carbon sequestration). On each farm the base line of each of the components of the index would be established in order to determine increments and the level of incentives for further expansion of the area under silvopastoral technology. Changes on each farm would be monitored once per year using the methodology developed by CATIE. Payments would cover land set-aside for ecological purposes, as a forest, for example, inside the same farm. Such a system of payment for ecological land use would provide the farmer with the option to have silvopastures in the entire farm, but also to establish a biological corridor (for biodiversity or to sequester carbon). Particular attention would be paid to the linked objectives of soil quality improvement and the mitigation of green house gas emission. Carbon storage would be therefore be established on each farm in order to determine increments and the level of incentives for further expansion of the area under silvopastoral technology, and changes in carbon on each farm would be monitored once per year using the methodology developed by CATIE. The incentive levels to promote land use changes, which provide global environmental benefits will be defined at appraisal. In any case they would be moderate. Tentatively, they would be based on

the equivalent of US $ 1-10 per ton Carbon stored (based on current accepted global standards), and US $20 per ha set-aside (on the basis of initial return estimates of silvopastoral technologies on farm).

- Payments for biodiversity conservation as a "Biodiversity Conservation Prize" at a farm and community levels. In order to promote land management practices compatible with biodiversity conservation, a system of incentives consisting of several prizes would be established for each region covered by the project. Prizes would be given both to community groups and individual farmers, as a reward for individual contributions to local biodiversity and regional conservation impact of community actions.

  Prizes to farmers. The initial description of the landscape units made at the beginning of the project, and the bird list completed after the first six months of the survey would be used as the baseline to compare changes over the implementation of the new land management practices. Several indicators of sound practices would be used to grant the prizes to farmers:

- Percentage of original area converted to silvopastures.
- Increase of connectivity among natural components of the landscape.
- Diversity of strata within the silvopastures, and floristic diversity across the farm.
- Significant, positive change in the Komar index applied to bird data.

Prizes would be granted each year. During the first two years of the project, prizes would consist of inputs for further expansion or improvement of the silvopastoral areasm through select native trees and shrubs, and agricultural supplies to help the farmers to further increase the area covered by forest habitat within their properties. At the end of the five year period, all the farmers participating in the project that have demonstrated some improvement of their lands for biodiversity would be given a diploma by the American Bird Conservancy certifying that livestock production in their properties is biodiversity-friendly. A copy of the certification would be sent to the national authorities in charge of biodiversity conservation as a recommendation for the farms to be accepted within the regional systems of protected areas either as private nature reserves, nature refuges, or demonstration sites for biodiversity-friendly productive systems. Three winners would be chosen among the participant farmers to receive a prize consisting in a visit to an ecotourism site in order to get basic training about the establishment of such kind of enterprise.

Community Prizes. As soon as the project would be initiated, a workshop would be held at each region to explain the long-term objectives of the project, and to provide basic information to community leaders and schoolteachers about the importance of biodiversity conservation centred on birds as indicators of environmental health. The importance of birds as tools to promote conservation actions would be emphasised, and some guidelines as to how to protect and improve both natural habitats and agro-ecosystems for bird conservation would be provided. It is expected that this workshop would result in the organisation of local groups interested in conservation in the target areas. During each visit of the biodiversity technician to the study area, interviews with local leaders and teachers would be arranged in order to stimulate their work.

At the end of the first year of the project, the American Bird Conservancy would make an evaluation of community involvement with the project, and a second workshop would be arranged to strengthen the community efforts about conserving the local biota. At this workshop a set of nature books, pamphlets and posters, as well as computers and software would be given to a school selected by the participants to help them develop activities related to nature appreciation and conservation in the area. A similar activity would be carried out at the end of the second year, when a booklet on birds and conservation specially designed for each region would be distributed to the participants to boost their interest and increase their pride in local natural resources.

At the end of the third year, one community leader chosen by the participants in the project would receive a prize consisting in joining the winners of the farmers' contest in visiting an ecotourism enterprise to get training on community development around this kind of activity.

4. Policy formulation and decision support:

Assemble policy guidelines for sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use and environmental services.

Policies guidelines would be supported with policy analysis and the development of decision support tools. The analysis would focus on key policy constraints, i.e., environmental unfriendly distortions in land tenure and input and output pricing, infrastructure policy, and constraints to community empowerment. The results of these analyses would be in integrated into modelling programs and the LEAD toolbox for environmental impact assessment containing specific recommendations for best ranching practices and land use that improve habitat heterogeneity to sustain higher biodiversity, and increase productivity, guidance for future funding for environmental services, lessons for replication and for best practice, fair trade agreements, certification of livestock products, agro ecotourism and policy requirements for environmental services in livestock production. The policy formulation activity is closely linked to the monitoring program, therefore a full description is given under numeral 6 (monitoring and evaluation plan). Other activities for dissemination of policy guidelines and decision support tools among Egos, community-based groups, and policy-makers would be undertaken.

- Workshops for policy formulation: A total of 9 consultations per country.

- Meetings to assemble policy guidelines: three steering committee meetings.

- Policy analysis: One major review per country/project area including review mission, and a workshop to develop computer programs for modelling change on land use, soil organic matter changes, and biodiversity under silvopastoral systems. The data collected in the three countries would enable the development of a general computer model and decisson support for policy and decision makers, to explore the alternatives for a particular ecosystem; or at a farm level, to make adjustments to the farm management in an interactive way. The model could be set to, for example, calculate the incentives for silvopastoral expansion under particular conditions, to calculate economic return to the farmers, to optimise the number of hectares or animals needed to maximise the soil improvement and biodiversity conservation, etc.

An environmental impact assessment toolbox assembled and distributed at each pilot.

5. Project management

Incremental expenses related to management of the project alternative would include salaries at CATIE and the participating organisations for a project co-ordinator and financial project manager who would direct and monitor project activities and advancements. New auditing procedures would also be put in place to satisfy GEF-WB project requirements. Implementing the alternative would increase some operational costs and expenditures.

- Appointment of experts and assistants for administration and organisation of project in each country
- Organise project account system in each country.
- Complete final audits, evaluations and final review.
- Co-ordination activities.

Activities and indicators	
Planned activities to achieve outcomes	**Indicators**
1.1 *Ecosystems enhancement.* To establish, at farm level, at least 3, 500 ha improved silvopastoral systems, which would provide a variety on ecological services in an area of 35,000 ha.	1.1.1 Farms and communities selected and silvopastoral plans being implemented: Within each project area, between 40 and 200 farms identified, and for each farm a silvopastoral improvement plan prepared, and the inputs (seeds, etc.) supply organised 1.1.2 Extension workers and local assistants recruited: For technical support, 6 months expert on production systems, 17 months national expert and 84 months field assistant in Nicaragua and Costa Rica; and 24 months expert on silvopastoral systems and 84 months field assistant in Colombia).
1.2. *Capacity building*: Technically assist stakeholders, strengthen local organisations and produce communications on integrated ecosystem management and in the implementation of sustainable livestock production systems.	1.2.1 Consultants and experts on communication and dissemination to built a communication strategy among stakeholders appointed: 2 months expert consultant and 6.6 months national expert in Nicaragua and Costa Rican, and 8.4 months expert consultant in Colombia. 1.2.2 Community training programs for target groups completed. Number of training programs developed for each country: 60 small workshops for 10 – 20 farmers and 120 workshops, for planning and follow up activities for groups of 6 - 8 farmers in each country, 2 one day workshops with local community). Workshops and seminars with local organisations completed (9 in each country). 1.2.3. Horizontal transfer of knowledge among stakeholders completed. Number of farmers trained, for each country 126 one day farmer to farmer exchange field trips. 1.2.4 Extension material developed: 1 video, 6 booklets, 4 books and 1 technical manual in each country. 1.2.5 Electronic conferences at global level carried out (2 electronic conferences) and dissemination material and model made available in the Internet.
2 *Monitoring Environmental Services:* Obtain improved information and understanding of the potential of intensified silvopastoral systems in providing global ecological services and local socio economic benefits.	2.1 Consultants and technical staff appointed, for development of monitoring system: Recruitment: 2 months expert consultant, 14 months national expert consultant, 17 months local assistant, in the case of Nicaragua and Costa Rica; and 14 months expert consultant and 17 months local assistant in the case of Colombia. Monitoring systems for the different ecosystems aspects established (Equipment and services in place). 2.2 Technical monitoring of bird species established (per country basis: 72 months field assistant, 12 months consultant). 2.3 Land use monitoring completed: 2 months consultant, 10 months national expert, 35 months local assistant in Nicaragua and Costa Rica and 2 months consultant, 7.6 months national expert, 36 months local assistant in Colombia recruited. 2.4 Technical monitoring of water quality in watersheds using biological indicators established: (per country basis: 72 months field assistant, 12 months consultant). 2.5 Technical monitoring of socio-economic aspects carried out (In each country: 6 months expert consultant, 30 months national expert and 35 months local assistant in Nicaragua and Costa Rica and; 34 months expert consultant and 35 months local assistant in Colombia).
3. *Incentives for Eco-Services (Eco-services Fund):* Gain experience on beneficiaries response to incentives for farm's investments in biodiversity conservation and carbon sequestration to produce global environmental benefits.	3.1 Fund established. 3.2 Incentives system for ecological services established: Current proposal: 3.2.1 Up front costs covered (up to 50%of establishment costs of silvopastoral systems provided by Eco-Services Fund). 3.2.2. Payments for biodiversity conservation as a "biodiversity conservation prize" at a farm and community levels carried out (1

	prize/year for incremental bird biodiversity in each country). 3.2.3 Payments for investment activities that lead to landa use changes at the farm level (1 payment/year to each farmer in each country), in line with Index prepared.
4. *Policy formulation and decision support:* Assemble policy guidelines for sustainable intensification of livestock production and specific recommendations for sector and environmental policies in terms of land use and environmental services.	4.1 Workshops for policy analysis and formulation carried out (9 consultations per country). 4.2 Meetings to assemble policy guidelines (3 steering committee meetings). 4.3 Programs for modelling carbon sequestration, change on land use, and biodiversity under silvopastoral systems developed. 4.4 An environmental impact assessment toolbox assembled and distributed at each pilot.
5. *Project Management*. Strengthen the administrative and organisation of the collaborating institutions.	5.1 Experts and assistants for administration and organisation of project appointed (6 months expert consultant, 34 months of national expert, and 70 months of field assistant in Nicaragua and Costa Rica, and 36 months of national expert, and 70 months of field assistant in Colombia). 5.2 Project account system set up in each country. 5.3 Final audits completed. 5.4 Evaluations realised. 5.5 Final review accomplished.

Country specific project descriptions

Colombia

1. The ecosystem

The area selected for the project would be a corridor in departments of Quindia and the Valle Del Cauca. The region is recognized by its high biological diversity, and it is strategic location for the genetic flow between the Andes and the Choco region. It is located in the so called Pleistocene haven of the high Cauca, characterized by high levels of endemism of vascular plants, insects and vertebrates. The Chocó bio-geographic region is one of the most threatened, biologically diverse ecosystems in the world. The human settlement process, the intensive agriculture, the drainage of wetlands and deforestation have transformed the natural ecosystems. Annexes 10 and 11 provide respectively a description and a map of the geographic and substantive complementarities with GEF and other donor funded projects. There is no duplication of activities with these other projects..

1.1 The physical environment

The sites selected for the project are located in the south east of Colombia, in a zone of 800 km^2 in two eco-regions: the Cauca valley and in the slopes of the Central Andes, between 3 and 4° N and 75° W. Both zones are representatives of livestock production systems in Colombia and in many other Andean countries. The zones have a gradient of climatic conditions and life zones (according to Holdrigde) summarized in table Annex 2.1

Table Annex 2.1 Physico-biological conditions in the project zones in Colombia.

Eco-region	Altitude metres	Temperature Celsius.	Rainfall mm /year	Life Zone
Valley of Cauca river	900-1000	x 24-28 max. 34 min 16	800 – 1700 bimodal 2 dry, 2 rainy seasons	bs-T, bsh-T
Quindío. Slopes of the Central Andes	1.150 - 1350	x 22 –25 max. 28 min 15	1200-2000 bimodal 2 dry, 2 rainy seasons	bs-T, bsh-T, bs-PM, bh-PM

* bs-T (tropical dry forest), bsh-T (sub humid tropical forest), bs-PM (dry forest pre-mountain), bh-PM (humid forest pre-mountain).

Soils originated from different process: alluvial deposits (valley of Cauca river and river banks in watersheds) and volcanic ashes (Quindío region in slopes of Central Andes). Soil characteristics in the region are provided in Annex table 2.2

Table Annex 2.2 Soil conditions in the project zones in Colombia.

Eco-region / Range	Classification	Chemical Properties	Physical properties	Topography
Valley of Cauca river	Mollisol, Inceptisol, Vertisol, Alfisol	pH neutral to alkaline, high phosphorus, high cation exchange capacity, medium to low organic matter.	Clay to loam-clay, deep soils, ground water level from medium to high.	Plain to low slopes < 10%
Quindío. Slopes of Central Andes	Typic Dystropepts, Typic Hapludalfs, Typic Hapludads, Dystrandepts or Andic	pH acid, low phosphorus, medium to low cation exchange capacity, high Fe, from high to very low organic matter.	Loam, loam-sand, loam-clay soils.	Undulate to very steep slopes, 25 to 60% gradient

The most important watershed for the two eco-regions is the Cauca valley river, which is a 1000 km affluent of the main Colombian river, the Magdalena river. The watersheds included in the project area are all affluent of the Cauca river.

Table Annex 2.3 Watersheds in the Colombian project zones

Watersheds	Area (ha)	Volume of flowm^3/s
Amaime	87.373	9.0
Zabaletas	17.260	4.0
Guabas	19.769	8.0
Sonso	13.945	5.0
Guadalajara	13.796	4.5
Tuluá – Morales	108.662	21.0
Bugalagrande	87.510	25.0
La Paila	48.448	4.5
La Vieja	63.831	95.0

Land degradation on the Quindío slopes is evidenced by the accelerated processes of erosion and compaction due to the absence of plant cover, to overgrazing and the use of fire. This ecological damage has been caused by expansion of the livestock sector. Due to falling profitability of coffee in the early nineties, and increasing levels of rural insecurity, a substantial number of coffee growers switched to alternative activities including fattening of cattle. This situation has been exacerbated by the falling of the international prices of the coffee bean and the adoption of policies by the local authorities to stimulate the change from coffee to other agricultural activities. The latter entailed converting areas dedicated to growing coffee, for which the soil and climate in the region are ideal, into intensively managed pastures, at times on steep slopes, with stocking rates of more than eight animals per ha. After four years of conversion the ecological damage to soil structure is already clearly visible. Circumstantial evidence also suggests that the high rates of application of fertilizers are likely to have changed the chemical properties of the soil.

1.2 The biological environment

The haven of the high Cauca is considered one of the most important centers of endemism in Colombia and it is particularly rich in endemic bird species. These species are *Ammodramus savannarum caucae, Rallus nigricans caucae, Anas cyanoptera tropicus, Colombina talpacoti caucae, Colinus cristatus badius Conover, Zenaida auriculata caucae Chapman, Falco sparverius caucae Chapman* and *Phyllomyias griseiceps caucae Chapman.* The predominant vegetation cover in the sub Andean forests of the Quindío region are the Robledales forests (*Quercus humboldtii* associated to species of the genera *Alfaroa*, *Hedyosmum, Weinmannia* and *Clusia*) and the

Lauraceas forests (association of species of the genera *Nectandra* and *Ocotea*). In the more humid areas the predominant vegetation cover, are the forests of *Hedyosmum* and *Rubuacea* genera. In the Cauca valley dry forest is the predominant cover. The main plant species are, among others, *Pithecelobium dulce, Xylosma celutinum, Guzauma ulmifolia, Bursera tormentosa, Eugenia acapulsensis, Tessaria intefrifolia, Mimosa pudica* and other species of the genera *Euphorbiaceae, Ochroma* and *Cecropia*.

There are three protected areas in the region belonging to the National System of Natural Parks. These are the natural park "Las Hermosas" (between the Valle del Cauca and Tolima departments), the natural park "Los Nevados" (in the departments of Quindío, Tolima, Risaralda and Caldas) in the Central Andes and the national park "Tatamá" (in the departments of Risaralda and Chocó) in the West Andes. At present the Government is working towards the establishment of a Regional System of Natural Parks to include the conservation areas of the departments, municipalities, integrated management districts, especial areas for native and afro-Colombian communities and the private conservation areas. Future plans include the establishment of biological corridors between "Los Nevados and Las Hermosas, and between "Tatamá" and " La Serranía De Los Paraguas".

In the past, the valley of the Cauca river had an abundance of wetlands, approximately 15.000 ha. Along with the development of the agro-industry, these were transformed, almost completely by drainage and destruction of the associated vegetation. Today only remains relicts of small lagoons and one lagoon established as a protected area (Laguna de Sonso) which occupies only 12% of the original wetland area, and is under threat by sedimentation and chemical pollution. There are serious problems of land degradation in terms of salinization and drainage in the valley of the Cauca river in some 80.000 ha (35% of the total area) due to predominant agro-industrial production system. In the north of the valley there are no commercial tree plantations or reforestation programs and pastures, most of them degraded, occupy 90% of the area. The dry forest is the most endangered biome of Colombia, only 1.5% of its original area remains. This phenomenon is similar in other regions of America. Only 5.000 km2 remain of the tropical dry forest that once covered the Cauca valley and slopes of Central Andes, mainly in small relics in private farms.

Thus, the biota of the region is under threat. In the case of the flora, there are not data of extinct species, because the lack of historical records, but there are 147 endangered species belonging to 30 families (17% Gymnosperms, 7% Monocotyledonous and 22% dicotyledonous) of a total of 930 species. Regarding the fauna, there are a total of 40 bird species classified as extinct but there are no records for other species. Preliminary information suggests that the number of endangered species is: 21 of a total of 161 fish species (13%), 49 (34%) of 146 amphibians species, 40 (19%) of 160 species of reptiles and 127 (16%) of 818 bird species.

Some of these relicts are preserved thanks to their vicinity with livestock farms. Recent research by the Universidad del Valle and CIPAV, has demonstrated the importance of the silvopastoral systems to maintain and increase the diversity of birds, ants, butterflies and other animal species. In this way, the cattle farms managed with criteria of sustainability can be truly considered as islands of conservation of regional biodiversity compared with the homogenous landscape of mono crops of sugar cane, sorghum, soy bean and coffee. The relationship between the cattle farming and the protected areas is extremely important because only with the re-conversion of the conventional cattle farming would be possible to advance in the application of the principles of sustainable management of watersheds and conservation of forests, páramos and wetlands.

2. Development options

Without Project Without fundamental technology and policy changes, the current eco-systems degradation in the Quindío-Cauca corridor would persist. From the south sugar cane plantations would continue to take arable land, the rest being utilized for conventional cattle ranching (open grasslands where only one or two grass species are favored and only scattered big trees are left for shade for the animals). The pressure from the sugar cane industry depends on the international prices for sugar, so if prices are low, agricultural land would be devoted to conventional cattle ranching or vice versa. From the point of view of the environment, neither of these activities contribute to the diversity of the corridor due to their mono-crop nature. From the north, the local policies would continue to promote the change of land use from traditional coffee growing under the shade to other activities in order to keep coffee prices high. The major trend is to change to conventional cattle ranching with the

consequences on land degradation aforementioned. In the Central Andes in Quindío in the last eight years more than 15,000 ha have been transformed from coffee plantations into cattle systems due to plant health problems and poor yields. Something similar, but without consolidated data, exists in the same eco-region for the department of Risaralda. By continuing the trend of soil degradation, loss of bio-diversity and water contamination, the cattle farms would lose the possibility of taking care of the increasing demand of products of animal and forest origin as well as the provision of environmental services.

With Project The project would work towards the conservation and enhancement of this corridor by introducing sustainable cattle production systems and at the same time working with the local environmental authorities to develop technological and policy responses to counter further ecological deterioration. The provision of adequate advisory services and the payment for ecological services, would greatly increase the adoption of sustainable cattle production technologies. The project would therefore have the following activities:

Selection of about 40 farms in the project area to accelerate the introduction of intensive silvopastoral systems. About 40 farms (total area about 2000 ha) would be selected in the corridor to maintain and increase the area of conservation. Farms plans include: introduction of more productive grassland and the greater use of shrubs and trees, which can be used at the same time as fodder. A wide diversity of shrubs and trees are now available and would be introduced. For the cropping areas, "no-till" techniques, and the use of cover crops would be encouraged to maintain soil fertility, and reduce run off and hence water pollution.

Establishment of the Eco-Services Fund. The project would, through a fideicomiso, establish an Eco-services fund, which would pay 40 selected ranches for the global services of carbon sequestration and increased bio-diversity, through initial investment grants and action grants on the basis of quantitative parameters of land use changes and the increase in the bird population (numbers and species diversity) as an indicator for overall bio-diversity increase.

Creating the capacity to introduce the technological package and monitoring capacity. The project would create the capacity in the extension service to disseminate the new technologies, and support this service in training of ranchers and community groups in those technologies. The emphasis would be in the initial phase on the selected farmers, and would in the second phase shift to other groups in the country. CIPAV would further develop the monitoring methodology for water quality using biological indicators. In addition, the project would monitor the effect of the land use intensification on the main biological (carbon, bio-diversity, water) and socio-economic parameters, following the methodology developed by CATIE under the project.

Disseminating the results. The results would be translated through preparation of environmental assessments toolboxes into policy guidelines and workshops for integration in policy formulation.

Project benefits The project would take advantage of the market opportunities for plant and animal origin as well as the sale of some environmental services which at the present time do not have a proper value. Thus is would directly lead to the sequestration of about 2,000 ton Carbon per year, and the conservation of some critical fauna. But more important even might be the indirect effect the project could have on the environmental effects of cattle ranching. Cattle reconversion is an urgent priority for the environmental authorities, but these lack effective instruments of policy and technology. The project would allow an alliance between the cattle productive sector and the environmental authorities, a very significant fact for Colombia where ninety percent of the agriculture frontier of more than 40 million hectares are dedicated to the pastures and in this sense the project is pioneering for the country.

For the sustainable soil management there are already regional recommendations that are being adopted in the Land Use Plan, especially in Quindío, related to the agroforestry and cattle ranching systems. The project would harness some of them and would ensure the completion of alternatives where an institutional consensus has already been reached. These are:

- The introduction of preventive practices of soil conservation such as the presence of trees and shrubs associated to the agricultural and cattle production.

- The integration of cattle into agricultural production systems and to increase the content of the organic matter and to improve the physical, chemical and biological characteristics of the soil.
- The implementation of agroforestry systems, that allow a reduction in artificial fertilizer dependency, to reduce erosion and compaction of the soil, stimulate the cycling of nutrients, establish multi-layered agro-ecosystems and, in the case of the cattle ranch, generate a better environment for the animals.
- The promotion of the organic fertilization of the crops, grass and forages. With this practice it is possible to manage medium and long term to improve the physical, chemical and biological characteristics of the soil
- The identification of productive alternatives different from the intensive cattle ranching of pasture with heavy animals on steeply sloped areas. These can include set-aside systems of partial or total enclosure of animals, fed through the cut and transport of forages that include trees and shrubs as well as the establishment of agroforestry systems and forests in the freed areas.
- The promotion of the biological conservation of native forests and establishment of guadua and biological corridors with these species.

The relation of the cattle ranches with the natural habitats conservation is fundamental since only the environmental reconversion of this activity would allow an advance in the application of the principles of sustainable handling of the river basins and the conservation of the wooded areas, deserts and swamps. The option developed by the pioneers of the private reserves already recognized by the State from 1993 law 99, allows clearly to put activities of the cattle ranch under agroforestry systems as a friendly use with fragments of natural habitats.

Site specific technology options

The project would introduce several types of silvopastoral systems but the emphasis will be given to high arboreal density and cut and carry systems. For the high arboreal density systems two types of associations would be considered: a two strata system (tree:pasture) *Leucaena leucocephala: Cynodon plectostachyus* and a three strata system of *Cynodon plectostachyus, Leucaena leucocephala* and *Prosopis juliflora*.

Cut and carry systems would be implemented as protein banks and multiestrata fodder banks. Protein banks would be more suitable for medium size farms where land can be devoted for this purpose. For small farms the multiestatra fodder banks would be preferred. They provide feed for the animals (not only to cattle, but a to variety of other farm animals) and, given their multipurpose characteristics, they also provide food and medicinal plants for the family and for the market. *Gliricidia sepium* and *Leucaena leucocephala* would be the species more adapted for protein banks in the region, while multiestrata fodder banks will have as the fodder species: *Trichanthera gigantea, Erythrina spp., Tithonia diversifolia, Morus nigra, Hibiscus* and *Malvaviscus spp.*

B. Costa Rica

1. Ecosystem

In Costa Rica, the project would cover two different eco-systems, i.e. Esparza, a tropical sub humid region, which is located in the Central Pacific region of Costa Rica, and La Fortuna, San Carlos, a tropical humid region, which is in the Northern Huetar Region of Costa Rica. Both regions are undulating with slopes ranging from 10-65 percent, with fragile ecosystems and evident land degradation. In particular La Fortuna area plays a critical role in the hydrology of Costa Rica. Both sites are important buffer zones for the most important conservation areas in Costa Rica; i.e. Esparza is in close proximity to Monteverde, and La Fortuna is in close proximity to the Arenal Conservation.

1.1. Physical environment

Climate

The Esparza region is classified as a tropical sub-humid forest with a seasonal rainfall pattern. Mean annual

rainfall is 2040 mm which is concentrated between the months of May and December. Mean daily temperature of Esparza is 26 °C . La Fortuna is classified as a very wet tropical rainforest with mean annual rainfall of 3000 mm and temperature of 26 °C. The relative humidity of this area can exceed 85% and temperatures over 28 °C.

Soils

The soils of Esparza are classified as "Typic Haplustalf" that moderately shallow (< 60 cm) and severely eroded. On the other hand soils of La Fortuna are classified as Alfisols and molisols and have good depth (> 100 cm), higher organic matter content and fertility parameters compared to those of Esparza

Hydrology

The Arenal watershed is located in close proximity to La Fortuna, and is the most important site in Costa Rica for the production of hydro-electricity, irrigation and potable water. Land degradation has negative effects on water quality in the Arenal conservation area. Water quality is in particular negatively affected by dairy farming, when sequential discharges of acidic and caustic soda washes and whey from the cheese making into streams.

1.2 Biological environment

Costa Rica is one of the richest countries in biodiversity in Latin America with a total of 1434 species and species index of 9.2 species per 1000 km^2. However, recent studies show that many species are rare and in via of extinction, because of high deforestation and unsustainable production systems.. The Monteverde cloud forest reserve, near Esparza, straddles the low continental divide in the Tiliaran, where the provinces of Puntarenas, Guanacaste and Alajuela meet. Monteverde's avifauna is derived from three principal regions: 1) The Guanacaste fauna on the Pacific slope which represents the southern extent of the Mesoamerican dry forest fauna 2) the highland fauna, a distinct group of species that occurs in the Costa Rican and 3) the wet forest fauna of the Caribbean slope. Monteverde's geography and climate with a steep dry season gradient of increasing moisture from Pacific to Caribbean slope create remarkably distinct vegetation in the different life zones and Avian species richness varies across the life zones. Zone 4 (lower montane rain forest) has the lowest species richness (121 regularly occurring species) perhaps because of its small geographical extent and isolation from the more diverse high elevation faunas. The Arenal Conservation area, near Esparza, is characterized by three altitudinal strata and three life zones and it has variety of biological richness of more than 1000 species of flora and 500 species of wildlife (fauna). This complements the presence of geological resources and a beautiful landscape, which is attractive to tourists.

1.3 Production systems

In Esparza, beef and dual purpose cattle production systems are the main land use systems. Beef production is characterized by low technology and is generally carried out on an extensive basis on farms of over 80 hectares. The use of inputs is low, labor use is scarce and in general very little management is applied. The pastures are grazed continuously, and the stocking rate is on average 0.7 Animal Unit (AU)/ha (Jansen *et al.*, 1997), similar to that found in other Central American countries. The main source of feed for animals is pasture (i.e. *Hyparrenhia rufa*) with only mineral supplementation. The dual-purpose system is characterized by a level of technology midway between the dairy producers and the extensive and semi-extensive beef producers. Animals used are crossbreeds of tropical Zebu and specialized dairy breeds. Average milk production is low, between 600 and 1000kg per lactation. Rainfall is concentrated in only 6 months of the year (May - November) and this does not favor year round production of forage. Severe feed shortage in the dry season results in heavy overgrazing, weight losses and, in extreme conditions, cow mortality. Pasture burning is common in some areas to promote regeneration of succulent shoots of high nutritive value. However, in hilly areas, it exposes the soil to the highly erosive rains at the beginning of the wet season, leading to land degradation. In Costa Rica deliberate fires are regulated by the ley forestal (forest law) which prohibits burning forests or areas adjacent to forests without a permit. Burning results in an estimated emission of 6 tons carbon/ha/yr.

Silvopastoral systems, which contribute to economic and biotic sustainability are slowly emerging. Live fence post (fences made from living trees) are found on more than 90% of cattle farms in Costa Rica unlike most developed

countries in which dead fence material is used. Living fence post and other agro-silvopastoral systems provide forage, shade for animals and other benefits including fuel wood, timber or fruit production. Nitrogen fixing trees improve soil fertility and more effectively recycle nutrients (Romero *et al*. 1994). Use of forage species in cropping systems can provide additional sources of nutrition to the animals in those systems. The area of Fortuna was deforested in the 70's and a high percentage of deforested land is under livestock production. In a recent CATIE study, three different livestock production systems were identified: specialized dairying; specialized dairying + crops (mixed) and dual purpose cattle farms. A high percentage of pastures in dual purpose farms are characterized with native unproductive grasses (*Paspalum sp*. and *Ischanemum cilare*) that support low stocking rates. About 25000 ha of pastures were found to have dispersed trees, a higher density of trees is found in La Fortuna, where dairying is practiced. In 1979, the forest law (4465) promoted the establishment of plantations including exotic species. Between 1980 and 1995, an area of about 30,000 ha of forest plantations was established in the Northern Huetar Region which includes La Fortuna. The main species established were: *Tectonia grandis, Terminala ivorensis, Bombacopsis quinatium and Gemelina arborea* (IICA 1995). In Esparza, the area under forest plantations has increased by about 5000 ha over the past years because of incentives from local and private institutions

2. Development Options

Without project. Over the past years, more intensive and diversified agro-ecosystems are emerging in the two regions. Monitoring of land use changes on cattle farms showed that the sowing of improved grasses supported a higher carrying capacity which resulted in the liberation of fragile pastures (> 20%) for reforestation programs. Farmers are now starting to plant native trees in the pastures and or managing natural regeneration of trees in abandoned pasture sites (Ibrahim *et al*., in preparation). These land use changes contribute to increase in carbon sequestration and conservation of biodiversity; and would be greatly increased, if incentives are paid for these environmental services.

With Project. The provision of adequate advisory services and the payment for ecological services, would greatly increase the adoption of these technologies. The project therefore would therefore have the following activies

Selection of about 200 ranches in the two project areas to accelerate eco-systems functioning through the introduction of more intensive forms of pasture management. About 200 ranches (15,000 ha) would be selected over the two project areas, to the extent possible in a block, to ensure the continuity of the landscape improvement. For these ranches, farm plans would be prepared. These plans would include the introduction of more productive grassland, and above all, the greater use of shrubs and trees, which can be used at the same time as fodder. Moreover, the project would encourage the use of fodder conservation technologies to feed cattle in the dry season, such as hay and silage making, to reduce overgrazing during that period. For the cropping areas, "no-till" techniques, and the use of cover crops would be encouraged to maintain soil fertility, and reduce run off and hence water pollution.

Establishment of the Eco-Services Fund. The project would, through a fondo fideicomiso, establish the Eco Services Fund, which would pay the 200 selected ranches for the global services of carbon sequestration and increased bio-diversity, through initial investment grants and action grants on the basis of quantitative parameters in land use changes, and the increase in the bird population (numbers and species diversity) as an indicator for overall bio-diversity increase.

Creating the capacity to introduce the technological package and monitoring capacity. The project would create the capacity in the extension service to disseminate the new technologies, and support this service in training of ranchers and community groups in those technologies. The emphasis would be in the initial phase on the selected farmers, and would in the second phase shift to other groups in the country. In addition, CATIE would further develop the monitoring methodologies, and establish the system to assess the effect of the land use intensification on the main biological (land use as related to carbon sequestration, bio-diversity, water) and socio-economic parameters.

Disseminating the results. The results would be translated through mathematical modeling and environmental

assessment toolboxes for policy guidelines and workshops for integration in policy formulation.

Project benefits. Based on results generated in studies conducted by CATIE and local institutions, a representative cattle farm (dual purpose farm) of Esparza and San Carlos was used to determine the effect of different pasture/silvopastoral technologies and on C sequestration.. In Esparza and Fortuna, there were significant benefits in carbon sequestration with the use of improved technologies which could amount to about 4,000 ton per year, as shown in table annex 2.4 and 2.5 technological changes would also reduce erosion by about 500 – 600 ton per ha per year, because of higher infiltration rates (table Annex 2.6 and 2.7). Additionally, establishment of silvopastoral systems are known to increase bio-diversity and would contribute to improve water quality.

Table Annex 2.4 Effect of land use changes on production and carbon sequestration on a 50 ha farm, Esparza, Costa Rica.

	Without project	**With project**
	Area (ha)	Area (ha)
Native pastures	40	10
Silvopastoral systems	0	10
Improved fallows	5	15
Secondary forests	5	15
Total	**50**	**50**
Stocking rate	0,63	1,32
Milk production (l $year^{-1}$)	32193	48198.2
Beef production (kg/year)	1700	1800
Carbon soil fixation (t C $year^{-1}$)	57,5	272,5
Carbon wood fixation (t C $year^{-1}$)	7,5	42,5
Carbon fixation (t C $year^{-1}$)	65	315
Wood production (m^3 $year^{-1}$)	25	150
Milk benefits (US$ $year^{-1}$)	16096.5	24099.12
Beef benefits (US$/year)	2040	3024
Wood benefits (US$ $year^{-1}$)	1125	6750
Carbon benefits (US$ $year^{-1}$)	420	2060
Total benefits (US$ $year^{-1}$)	19681.5	35933.12

Table Annex 2.5 Effect of land use changes on production and carbon sequestration, on a 50 ha farm in La Fortuna, Costa Rica.

	Without project	**With project**
Native pastures (ha)	50	7
Improved pastures (ha)	0	5
Silvopastoral systems (Forage) (ha)	0	5
Silvopastoral systems (Isolated trees) (ha)	0	5
Fallows (ha)	0	28,0
Total (ha)	**50**	**50,0**
Stocking rate, AU/ha	0,63	1,5
Milk production (l $year^{-1}$)	45990	54801,1
Beef production (kg/year)	2040	2880
Carbon soil fixation (t C $year^{-1}$)	0	317,0
Carbon wood fixation (t C $year^{-1}$)	0	10,0
Carbon fixation (t C $year^{-1}$)	0	327
Wood production (m^3 $year^{-1}$)	0	150
Milk benefits (US$ $year^{-1}$)	22995	27400,55
Beef benefits (US$/year)	2448	3456
Wood benefits (US$ $year^{-1}$)	0	6750
Carbon benefits (US$ $year^{-1}$)	0	2002
Total benefits (US$ $year^{-1}$)	25443	39608.55

Table Annex 2.6. Impacts of land use change on erosion in Esparza

Land use	Hydric erosion t ha^{-1} year^{-1}	Hydric erosion (t year^{-1})	
		Without project	With project
Native pastures	25	1000	250
Silvopastoral systems	7	0	70
Improved fallows	10	50	150
Secondary forests	10	50	150
Total		**1100**	**620**

Table Annex 2.7. Impacts of land use changes erosion in La Fortuna.

Land Use	Hydric erosion t ha^{-1} year^{-1}	Hydric erosion (t year^{-1})	
		Without project	With project
Native pastures	25	1250	175
Improved pastures	15	0	75
Silvopastoral systems (Forage)	7	0	35
Silvopastoral systems (Isolated trees)	7	0	35
Fallows	10	0	280
Total		**1250**	**600**

Site specific technology options

The project would consider all types of silvopastoral systems for the project area but emphasis will be given to the following systems live fencing, wind-protection shields and specially biological corridors in the farms. For live fencing and wind protection shields the following species would be considered: *Gliricidia sepium, Prosopis juliflora, Trichanthera gigantea, Tithonia diversifolia, Morus spp., Hibiscus spp* and *Malvaviscus spp.*

Biological corridors in the farm should be very complex in terms of diverstiy of plant species. They would include appart from the fodder species aforementioned, a good variety of local tree species including: *Terminalia amazonia, Dipteryx panamensis, Hieronyma alchomeoides, Calophyllum brasiliense, Vochisia guatemalensis, V. ferruginea, Swietenia macrophylla, Tectonia grandis* and *Gmelina arborea*. They would also include palm species of the genera *Sabal, Attalea*, and *Syagrus* among others.

C. Nicaragua

1.1. The Eco-system

The proposed project area in Nicaragua is located in the central zone, in the department of Matagalpa, at about 140 km from the capital of the country, Managua. It consists of an undulating terrain, with extensive livestock on the basis of the native pasture, and crop cultivation as the main land use. Overall, the project area is classified as a tropical to sub-tropical rainforest, with an average temperature of 25 C. and an average annual rainfall between 1700 (in eight months) and 2500 (in ten months), as one moves from west to east. Of particular interest are the reserves of the massif of El Musun, which still retains some of its primary medium altitude humid forest, and the reserve of the Quirragua.

1.2 The Physical Environment and Landscape

The project area covers two districts, Matiguas and Rio Blanco, and stretches between 300 and 1400 mn. The area contains a number of mountain chains, cut by the valley of the Rio Grande de Matagalpa, with numerous tributaries. The strong hilly area, previous under tropical forest, rich in fauna and flora, is now almost completely used for crops and extensive pasture. As a result, the soils, mostly acid clays, have eroded, and soil fertility has

declined, in particular in the deeper soil layers. There are few flat areas, and they are generally poorly drained, and hence inundated in the rainy season.

1.3 The Biological Environment

Except in the above mentioned reserves, there is practically no primary forest left in the project area. The colonization started in this region already in the forties and was practically completed in the eighties. The colonization proceeded as in most of Central America. It started with wood extraction, then continued with the conversion of the land (often through slash and burn) for the production of grain for humans and livestock, and, after soil fertility is depleted under arable farming, a further conversion into extensive livestock production. Towards the higher areas, there is some coffee and cacao. With the proximity of the markets, some intensification of livestock production occurs. The average size of the livestock ranches varied between 70 and 200 ha. The land use pattern of the project area is provided in the table Annex table 2.8

Table Annex 2.8 Land use in the project area.

Land use (1996)	Share (%) of the area
Crops	12
Pasture	70
Fallow land	11
Forest	6
Others	1

Secondary forest vegetation is found in the galleries of the many water ways, and with the intensification, increasingly on the ranches. They are often used as dry season fodder for cattle, in particular for the dairy farms near the towns. The increase in the price of the construction wood in Managua, has also led to more forestation. Re-conversion to crop land, and the use of fire in pasture management are the main sources of loss of the secondary forest cover. The current extensive forms of pasture production, and the continuos re-conversion of land to cereal production constitutes the main source of environmental degradation, as it leads to water pollution because of soil erosion and sedimentation and to carbon emission, because of continued “slash and burn” and mechanized deforestationand land preparation.

2. Development Options

Without project. Without a further stimulus for intensification, the most likely development path will be a continuation of the current timid pace of intensification, leaving the large majority of the area for some time to come under the current practice of conventional livestock and crop production, with overgrazing and use of fire, and hence continued sedimentation of the water ways, further loss of bio-diversity and continued emission of Carbon-dioxide. Catering for the increased demand for livestock products in Nicaragua would come from the expansion of the area of traditional pasture at the cost of the little primary forest that still exists in the area. It would also encourage the migration of smallholders and subsequent deforestation of other areas. The "ganaderization" of the landscape will continue. It will seriously endanger some of the natural reserves in the region, such as those of Bosawas to the North East of the project area. Soil erosion will continue, and the area will continue to be a net emitter of Carbon dioxide.

With project interventions. With the project, the emphasis would shift from a horizontal expansion of low yielding pasture land to a more intensive use of the current area under pasture. This would include:

Selection of about 200 ranches in the area to introduce more intensive forms of pasture management. About 200 ranches (15,000 ha) would be selected in the project area, to the extent possible in a block, to ensure the continuity of the landscape. In line with the World Bank/IDA strategy for Nicaragua, preference would be given to smallholders. For these smallholders, farm plans would be prepared. These plans would include the introduction of more productive grassland, and above all, the greater use of shrubs and trees, which can be used at the same time as fodder. Moreover, the project would encourage the use of fodder conservation technologies to feed cattle in the dry season, such as hay and silage making, to reduce overgrazing during that period. For the cropping areas, "no-till" techniques, and the use of cover crops would be encouraged to maintain soil fertility, and reduce run off and hence water pollution.

Establishment of the Eco-Services Fund. The project would, through a fondo fideicomiso, establish an Eco-services fund, which would pay the 200 selected ranches for the global services of carbon sequestration as confirmed by land use changes and increased bio-diversity.

Creating the capacity to introduce the technological package and monitoring capacity. The project would create the capacity in the extension service to disseminate the new technologies, and support this service in training of ranchers and community groups in those technologies. The emphasis would be in the initial phase on the selected farmers, and would in the second phase shift to other groups in the country. In addition, the project would monitor the effect of the land use intensification on the main biological (carbon, bio-diversity, water) and socio-economic parameters, following the methodology developed by CATIE under the project.

Disseminating the results. The results would be translated through mathematical modeling and environmental assessments toolboxes translated into policy guidelines and workshops for integration in policy formulation.

Project benefits. The above actions would greatly accelerate the pace of replacing the traditional single species pastures with more diversified vegetation of improved pastures, shrubs and trees. This would increase the carbon sequestration by about 80,000 ton Carbon per year, diversify the landscape hence increase bio-diversity and reduce erosion and hence water sedimentation.

Site specific technology options

In Nicaragua, all silvopastoral systems are suitable for the project area but given the socio economic conditions the cut and carry systems would be preferred. For small farms the multiestatra fodder banks are the most suitable as they are a source of feed, food and medicinal plants. The fodder species most adapted in the region are: *Erythrina spp., Tithonia diversifolia, Morus nigra, Hibiscus and Malvaviscus spp.*

TO BE COMPLETED FOR WORLD BANK APPRAISAL

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Estimated Project Costs (to be further elaborated at appraisal)

Project Cost By Component	**Local**	**Foreign**	**Total**
	—————— US $ million ——————		
Total Baseline Cost			
Physical Contingencies			
Price Contingencies			
Total Project Costs			
Interest during construction			
Front-end fee			
Total Financing Required			

Project Cost by Category	**Local**	**Foreign**	**Total**
	—————— US $ million ——————		
Goods			
Works			
Services			
Training			
Other			
Total Project Costs			
Interest during construction			
Front-end fee			
Total Financing Required			

The incremental project costs (GEF + increment co-financing) by main expenditure category are provided below

Table Annex 3.3 Incremental cost

Category	GEF	Other Sources	Project Total (US$)
Technical Assistance	1,000,000	312,120	1,312,120
Workshops / Training	500,000	168,210	668,210
Goods	250,000	54,000	304,000
Fund	1,300,000	200,000	1,500,000
Works	450,000	2,700,000	3,150,000
Services	300,000	0	300,000
Unallocated	200,000	129,426	329,426
Operational Costs	500,000	335,874	835,874
Project total:	4,500,000	3,899,000	8,399,000

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Incremental Cost Analysis

This project complements existing activities described in the section on the current situation (baseline course of action) and adds new activities (alternative course of action) to the baseline that are required to achieve global environment benefits. Under the baseline scenario, conventional systems would dominate the landscape. These conventional production systems have led to significant land degradation in the three countries, which is not conducive to promoting biodiversity conservation nor sequestering carbon nor preserving water quality.

Baseline Scenario

A number of activities in the three selected projects areas will be carried out by the local executing organisations and other organisations that provide a foundation of environmental research and management, determining the current course of action in the zones chosen for the project. On-going and future activities related to sustainable livestock production are separated into key areas relevant to the project. In the next five years (2001-2006) the following activities are planned in the project areas:

Colombia:

1. *Ecosystems Enhancement and Capacity Building*: Four projects will focus on training, communications on integrated ecosystem management and in the implementation of sustainable livestock production systems. The "*Re-conversion of cattle farming in the high Andes region in the Cauca valley*" project will be implemented by CIPAV and will emphasise the implementation of silvopastoral and agroforestry systems in regions between 1800 and 3000 meters of altitude (while the GEF alternative will work between 950 and 1,500 meters). This project is funded by the Ministry of Agriculture, Fondo DRI-IICA, programa Valle en Paz. A second project "*Environmental re-conversion of cattle farming in the Garrapatas river canyon in the Serranía de Los Paraguas – Valle del Cauca – Chocó*" will focus on milk processing and commercialisation and training. The third project "*Strengthening the Natural Reserves of the Civil Society*" will strengthen local organisations and support environmental awareness among stakeholders for conservation. This program is financed by World Wildlife Fund, Ecofondo, Holland and the Private Reserves. The project "*Support to the Private Reserves of the Cauca valley*" funded by Ecofondo, Red Nacional de Reservas de la Sociedad Civil and private farms, and implemented by CIPAV, focuses on training, the creation of environmental awareness and the development of sustainable production systems for agricultural production (not environmental considerations, such as provided by the GEF alternative, where intensification would be achieved through silvopastoral systems). The GEF alternative project would train the farmers in the production aspects of implementing a silvopastoral system and on the environmental services provided by these. The baseline costs for these activities are calculated as US$1,070,000.

2. Monitoring Environmental Services: There will be three research projects that will collect key information on the biodiversity of the region, including birds, and on the biological diversity of different agro-ecosystems. Funded by GEF and the Ministry of the Environment, the project *"Andean biodiversity"* will collect information and provide training in conservation and use of the biodiversity, and will provide common monitoring indicators. The *"Departmental systems of protected areas in the Valle del Cauca, Quindío and Risaralda"* is a project that seeks to attain biological information on the biodiversity of the region. The last project is financed by ABC and it is for monitoring birds in agro-ecosystems. The GEF project will focus on monitoring three environmental services provided by silvopastoral systems, using the methodology developed by IavH and the information collected in the region. The baseline costs for these activities are calculated as US$900,000.

3. Eco-services Fund: No projects will be developed for benefit sharing mechanisms in the region.

4. Policy formulation and decision support: Parallel activities in policy formulation will be carried out. The MMA/World Bank "*Natural Resources"* Project will develop policy for Sustainable Resources Management. The projects "*Departmental systems of protected areas in the Valle del Cauca, Quindío and Risaralda*"and "*Strengthening the Natural Reserves of the Civil Society*" have an important component in the development for regional policies for conservation. The MMA *"Andean Biodiversity* "Project has an important component related to co-ordination of sectorial policies for conservation and sustainable use of biodiversity. The GEF project would focus on the development of policy instruments for the payment of environmental services in silvopastoral systems. The baseline costs for these activities are calculated as US$ 1,164,000.

Costa Rica:

1. *Ecosystems Enhancement and Capacity Building*: Four projects are related to the implementation of sustainable livestock production systems in the regions of La Fortuna and Esparza. These are: *"Evaluation of multi-strata silvopastoral systems for recovery of degraded pasture lands in the Pacific region of Costa Rica"* funded by AVINA, CATIE and Hacienda Pacificam. This is a research project to select native multi-purpose tree species for silvopastoral systems and evaluation of tree-pasture-animal interactions. Based on the results of this research the GEF would finance the implementation of this system. The project *"Land-use changes and carbon flows in Central America"* which seeks to quantify carbon flows and modelling of carbon sequestration in forest ecosystems, will be funded by FINIDA (it does not include silvopastoral systems like the GEF alternative would do). "*Evaluation of the contribution of trees in the economic sustainability of livestock farms in San Carlos*" is a research program to determine the income generated from sale of timber and the income generated from carbon sequestered by trees in livestock farms, and it will be a base for socio-economic monitoring in the alternative. "*Trees out of the Forest TROF"*(FAO, EU) is a study which will contribute to the inventory of trees in different agricultural ecosystems. The baseline costs for these activities are calculated as US$2,400,000. The baseline focus is on <u>research projects</u> for silvopastoral intensification, while the GEF alternative would focus on <u>implementing silvopastoral systems</u> for environmental services.

2. Monitoring Environmental Services: CATIE would implement five projects to monitor environmental impacts of livestock farms. These projects are: *"Analysis of the impact in the adoption of improved pastures on land use changes in Costa Rica"*(particularly looking at the variation in soil fertility and productivity, and socio-economic results), funded by CATIE and UCR; *"Monitoring carbon flows under different vegetation in livestock farms*" funded by CATIE, is a research project to develop a methodology; *"TROPILECHE project: Evaluation of environmental impacts in improved pasture ecosystems*" (traditional environmental assessment) supported by ILRI and CIAT; "*Validation of timber based agroforestry systems in livestock farms in the pacific region of Costa Rica*" (validation of research on performance of different trees) funded by CAC; and "*Quantification of degraded pasture lands in Costa Rica and their potential for improvement*" financed by CATIE and MAG. The baseline costs for these activities are calculated as US$625,000. The Baseline would focus on <u>research and methodology</u> to monitor environmental impacts (and carbon sequestration), while the GEF alternative would <u>implement</u> these methodology and would focus on monitoring three environmental services provided in silvopastoral systems.

3. *Eco-services Fund:* Under the Baseline Scenario, the Government of Costa Rica—including MINAE, FONAFIFO, SINAC, and the Costa Rican Office for Joint Implementation (OCIC)— is mobilising resources directed to the conservation and sustainable management of forest ecosystems. Over the next five years, it is expected that the sum of disbursements for environmental service contracts through the ESP program in priority biodiversity areas would total approximately US$27.5 million. The GEF Ecomarkets project will support the conservation and sustainable management of forest ecosystems throughout Costa Rica through explicitly targeting resources for conservation easements in buffer zones of protected areas within the MBC/CR, including forests with high biodiversity values, forests which are important for watershed protection, and other priority areas. This program does not cover silvopastoral systems. The GEF alternative would focus on payments for environmental services provided by silvopastoral systems, and therefore complement the proposed project.

4. Policy formulation and decision support: CATIE will finance the project *"Land use changes and carbon flows in Central America: options for carbon management*" which aims to assess and model the carbon stocks and

flows in selected cases of different land-use systems in Central America, to integrate the information on carbon stocks and flows at the landscape and regional scale, to analyse the possible conflicts between what is globally optimal (in terms of mitigation of climate change) and what is locally desirable (in terms of other goals for forest management) at four different levels: a) landowner, b) local community, c) country, d) global and to incorporate the policy makers in an interactive process of assessment, valuation and definition of optimal forest policies in relation to climate change at national and regional scales. Supported by FINIDA, the project *"Developing of an expert system on the status of pasture degradation in areas with different biophysical and socio-economic conditions in the Pacific regions*" will assess land use changes and pasture degradation and the socio-economic conditions leading to pasture degradation and will identify policies for recovery of degraded lands (decision- tree-model). The GEF alternative would look into silvopastoral systems, and would focus on policy instruments for environmental services payments in silvopastoral systems. The baseline costs for these activities are calculated as US$500,000

Nicaragua:

1.`Ecosystems Enhancement and Capacity Building: Activities for capacity building in sustainable production systems will continue in the Rio Blanco region. These activities include workshops, seminars, publications and farmer to farmer exchanges. NITLAPAN will develop the projects *"Financial Services for Local Development*" (Rural Credit), *"Legal Services for Rural Development"* (Land Tenure Issues) and "*Research on local demand and supply of agronomic technology*" (Applied Research) that all contain a capacity building component related to silvopastoral systems. Other projects in the region by other organisations have strong capacity building components, that will serve as a base for the silvopastoral component: *"Credit, legal services, health and nutrition"* (Basic grain production) by the Catholic Church and *"Training and livestock re-stocking"*(Increase the number of livestock) implemented by the Instituto de Desarrollo Rural and funded by the Taiwan government, will conduct workshops for farmers and will produce manual for technical training. The MAG-FOR World Bank "*Forestry project"* and "*Agriculture Technology"* Project will promote reforestation and agriculture intensification. Baseline costs for all of these activities are calculated as US$1,596,000. The baseline will focus on more conventional technologies for agriculture intensification (i.e. with agrochemicals, fertilisers, electric fences) and reforestation for production, while the proposed alternative would focus on silvopastoral intensification, combining production and conservation objectives.

2. Monitoring Environmental Services: N/A.

3. Eco-services Contracts (Trust Fund): N/A

4. Policy formulation and decision support: . The MAG-FOR - World Bank *"Forestry"* and *"Agriculture Technology"* Projects will promote policies for reforestation and agriculture intensification. The project *"Credit, legal services, health and nutrition*" implemented by the Catholic Church will focus on policies related to conventional extensive livestock systems, while the proposed GEF alternative would focus on the policy instruments for environmental services payments in silvopastoral systems. The baseline costs for these activities are calculated as US$500,000.

Summary Baseline Costs and Benefits

Baseline Costs. Total expenditures under the baseline Scenario are estimated at US$ 9,674,500 million[1] including co-financing from the three executing agencies, the three Governments, International Donors and local NGOs.

Baseline Benefits. Benefits achieved by the baseline will be mainly at the local level and will include improved production, increased information on production systems, environmental impact monitoring systems, stakeholder training and increased awareness of environmental management. The baseline scenario does not provide technical nor financial support or training for activities leading to intensification for environmental objectives, and

[1] (including baseline project management equal to US$ 919,500),

providing environmental services provided by silvopastoral systems. The scope of the baseline is thus limited and it will not permit design or implementation of a comprehensive integrated ecosystem strategy. Implementation of the Baseline Scenario will result in limited carbon sequestration and protection of biodiversity, and limited capacity to sustainable natural resources management.. The efforts of international and national NGOs will result in a marginal increase in environmental awareness, and activities of development agencies will result in a limited increase in sustainable natural resource management. International donors have invested resources in eco-services initiatives in short-term, and these activities, however, are unlikely to ensure carbon sequestration or protection of globally significant biological resources, due to lack of an explicit focus on values of environmental services in silvopastoral systems, as well as institutional, financial, legal and socioeconomic constraints to implement them.

Alternative Scenario

The GEF Alternative - total cost of which would be $18,074,00, would build on the baseline scenario and would support a number of incremental activities needed to achieve global environmental objectives in the key project areas:

1. *Ecosystems Enhancement and Capacity building*
2. *Monitoring Environmental Services*
3. *Eco-Services Fund*
4. *Policy formulation and decision support*

The GEF Alternative would enable activities that are not included in the Baseline, including technical assistance on integrated ecosystem management, the implementation of sustainable silvopastoral systems, and environmental services provided by silvopastoral systems; data collection in three countries of the region, especially on environmental services under intensive silvopastoral systems (carbon storage, birds populations, biodiversity, and water quality); development and implementation of an Eco-Services Trust Fund, that would provide experience on benefit sharing mechanisms at farm and community level and beneficiaries response to incentives for biodiversity conservation and carbon sequestration that would produce global environmental benefits. It would furthermore provide policy guidelines for payments of environmental services under silvopastoral systems and specific recommendations would be provided for sector and environmental policies in terms of land use and environmental services. Furthermore, the experience of benefit sharing mechanism would be disseminated through a website and a Spanish speaking platform under the coordination of LEAD.

Costs. The total cost of the GEF Alternative is estimated at US$ 18,074,500 million, detailed as follows: 1. *Ecosystems Enhancement and Capacity building US$ 9.566 million* (*GEF financing – US$ 1.3 million*); 2. *Monitoring Environmental Services* – US$ 2,475 million (*GEF financing – US$ 750,000 million*); 3. *Eco-Services Fund* $ 1.4 million (*GEF financing – US$ 1.2 million*); *4. Policy formulation and decision support* – US$ 2.914 million (*GEF financing – US$ 0.65 million*); and, (e) Project Management – US$ 1.7195 million (*GEF financing – US$ 0.6 million*).

Benefits. These activities would result in changes in the ecosystem and natural resources management patterns and in the generation of global benefits, particularly by the development of alternatives to increase carbon sequestration, conservation of biodiversity, and water quality of a global value. The project would increase the likelihood of endangered species survival, protect endemic species habitat, promote restoration of biodiversity, improve water quality and watershed management, and it would contribute with reductions on the emissions and sequestration of carbon. The strong local participation and the positive economic impacts of the implemented silvopastoral technologies would produce a positive impact on the livelihood of farmers that would ensure long-term sustainability of the project activities. The policy formulation and decision support activities would allow the implementation of long-term strategies of biodiversity conservation, carbon sequestration and sustainable production at regional and global levels.

Incremental Costs. The difference between the costs of the Baseline Scenario (US$ 9.674 million) and the GEF Alternative (US$ 18.074m) is estimated at US$ 8.4 million. Co-financing of US$ 3.9 million of this increment has been mobilised as follows: US$350,000 from LEAD, US $ 2,900,000 from the beneficiaries, US $ 50,000

from ABC and US$600,000 from NITLAPAN, CATIE and CIPAV. The funding from LEAD would cover mainly the policy component and the regional co-ordination of the activities, consultation and dissemination of results through its Spanish speaking platform on livestock-environmental issues. It would also provide scientific backstopping through internationally leading scientists in the fields of carbon sequestration and related modelling, pasture improvement and environmental economics. The local contribution consists of training, extension, communications and local organisation, as well as institutional support. The requested GEF contribution is US$ 4.5 million. GEF funding is sought for the incremental costs of removing barriers to the adoption of integrated ecosystem management approach: creation of a Fund for the establishment of silvopastoral systems, monitoring of environmental services, capacity building, policy formulation, and project management.

This is summarised in the following table:

	Baseline US$	**GEF Alternative US$**	**Increment US$**		
	Total	**Total**	**GEF**	**Others**	**Total**
Activity					
Ecosystems Enhancement and Capacity Building	5,066,000	9,566,000	1,300,000	3,200,000	4,500,000
Monitoring Environmental Services	1,525,000	2,475,000	750,000	200,000	950,000
Eco-services Trust Fund		1,400,000	1,200,000	200,000	1,400,000
Policy formulation and decision support	2,164,000	2,914,000	650,000	100,000	750,000
Project Management	919,500	1,719,500	600,000	200,000	800,000
Total	9,674,500	18,074,500	4,500,000	3,900,000	8,400,000

Summary of Local Benefits of the Baseline vs Global Benefits of the Alternative				
Component	**Cost Category**	**US$ million**	**Domestic Benefit**	**Global Benefit**
Ecosystem Enhancement and Capacity Building	Baseline	5.066	Intensification of agriculture activities and increased production	
	With GEF Alternative	9.566		Intensification with silvopastoral systems for increased environmental conservation and global benefits (carbon sequestration, biodiversity)
	Incremental	4.5		
Monitoring	Baseline	1.525	Data for conventional environmental assessment; methodology for carbon sequestration and land use change.	
	With GEF Alternative	2.475		**MONITORING OF ENVIRONMENTAL SERVICES (CARBON SEQUESTRATION, BIODVERSITY, WATER)**
	Incremental	0.95		
Eco-Services Fund	Baseline			
	With GEF Alternative	1.4		Breaking one of the most important barrier for the establishment of silvopastoral systems that would help to sequester carbon and conserve biodiversity.
	Incremental	1.4		
Policy Formulation	Baseline	2.164	Agriculture production policies	
	With GEF Alternative	2.914		Increased capacity to integrate eco-services concerns (provided by silvopastoral ecosystems) into sectoral policies; Increased public awareness of the importance of conservation of globally significant biodiversity, carbon sequestration, and ecosystem management.
	Incremental	0.75		

Summary of Local Benefits of the Baseline vs Global Benefits of the Alternative				
Component	**Cost Category**	**US$ million**	**Domestic Benefit**	**Global Benefit**
Project Management	Baseline	0.915	Not applicable	
	With GEF Alternative	1.719		Not applicable
	Incremental	0.80		
TOTAL	**Baseline**	**9.674**		
	With GEF Alternative	**18.074**		
	Incremental	**8.4**		

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Cost Effectiveness Analysis Summary

To be provided after appraisal.

(Indicate currency, units, and base year)

	Present Value of Flows		Fiscal Impact	
	Economic Analysis	Financial Analysis[1]	Taxes	Subsidies
Project Costs				

Summary of benefits and costs:

Main Assumptions:

Cost-effectiveness indicators[2]

[1] If the difference between the present value of financial and economic flows is large and cannot be explained by taxes and subsidies, a brief explanation of the difference is warranted, e.g., "The difference between financial and economic costs arises from price controls on the inputs."

[2] These indicators should compare the project with a suitable comparator, e.g., unit project costs of alternative project designs or international standards.

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Financial Analysis

Cash flow and financial rate of return analysis

This analysis aims to assess the financial rate of return of the silvopastoral technology based on silvopastoral improvement of a 5 ha plot and commercial rates and prices. The analysis compares the "with project"and "without project" scenarios in incremental basis to estimate the cash flow and the financial rate of return of an average farm of 70 ha under conventional pasture management and the investments needed to convert 5 ha under silvopastoral technology.

Variables

Conventional farm

In this scenario a 70 ha farm in traditional pasture remains with the same structure and management for 15 years. The farm has 60 animals and a stocking rate of 0.5. The herd distribution is: 35 cows of which 17 are lactating, 17 heads a year to sale at an average of 350 kg and the rest are bulls, replacements and calves.

Cattle Sales: 17 animals/year x 350 kg x 0,85 US$/kg.
Milk Sales: 17 animals/year x 3 littres/d x 270 days lactation period x 0,26 US$/l.
Labour: 0.034 employment/ha x 1404 US$ salary/year (including family labour at market price)
Maintenance: Includes seeds, fertiliser, fence repairs: 20 US$/year.
Cattle Purchases: The herd distribution for this scenario assumes there is not need for cattle purchases.
Veterinarian medicine: Vaccinations and medicines 3 US$/head.
Supplementary Feed: There is not supplementary feed in this system.
Taxes: 10% of gross inflow.

Farm with silvopastoral system

In this scenario the farmers converts 5 ha of the land into a silvopastoral system and the remaining 65 ha continue with conventional management. Changes from conventional to silvopastoral are carried in two years (2.5 ha at the time). To cope with the lack feed for the animals while the silvopastoral systems are established, half of the animals are sold the first year. The stocking rate for the silvopastoral system is 5 while the 65 ha under conventional pasture have a stocking rate of 0.5. Under this conditions the farm reaches equilibrium at the 5th year without the need of buying new animals. Under this scenario there are 25 animals more than the conventional management (9 Aditional lactating cows, 9 aditional heads to sale and 6 aditional replacements). The herd distribution for a total of 85 animals is: 26 lactating cows, 26 animals a year to sale at an average of 400 kg and the rest are bulls, replacements

and calves.

Cattle Sales: 26 animals/year x 400 kg x 0.85 US$kg.
Milk Sales: 26 animals/year x 5.5 littres/day x 270 days lactation period x 0.26US$/l.
Labour: 0.26 employment/ha x 1404 US$ salary/year (farmer has to pay external labour).
Investment Incremental (additional):
Fencing: 100US$/ha.
Establishment cost: includes labour, plant material, land adaptation: 150 US$/ha
Incremental Working Capital.
Maintenance: Includes seeds, fertiliser, fence repairs, etc. 100 US$/year .
Veterinarian medicine: Vaccinations and medicines: 5 US$/head.
Supplementary feed: 26 Lactating cows x 270 days x 1 kg/head/day x 0.5US$/kg.
Taxes : 10% of gross inflow. The analysis is presented in following table.

Table annex 4c.1: Cash flow and financial rate of return analysis

Farm Budget: Conventional Pasture																	
Inflow: Gross Value of Production (US$)																	
Cattle sales	5058																
Milk sales	3580																
Other																	
Total Inflow	8638																
Outflow: Operating Expenditures																	
Labour	3342																
Maintenance	1400																
Vet medicine	180																
Suppl. Feed	0																
Other	0																
Taxes	864																
Total Outflow	5785																
Net benefit/farm	2852																
Net benefit/ha	41																
Farm Budget: Silvopastoral System																	
Incremental	**Year 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**		
Inflow: Gross Value of Production																	
Cattle sales	5058	2210	2947	4420	8840	8840	8840	8840	8840	8840	8840	8840	8840	8840	8840		
Milk sales	3580	3580	3580	4563	9126	9126	9126	9126	9126	9126	9126	9126	9126	9126	9126		
Other																	

Total Inflow	8638	5790	6527	8983	17966	17966	17966	17966	17966	17966	17966	17966	17966	17966	17966		
Outflow:																	
Investment (Establishment of Silvopasture plus herd expansion)																	
Fencing	250	250															
Incremental cattle		1000	1000	1000	1000	1000											
Establishment cost	375	375															
Other																	
Total	625	1625	1000	1000	1000	1000	0	0	0	0	0	0	0	0	0	6250	
Operating Expenditures																	
Maintenance	1400	1650	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900		
Labour		4254	4254	5167	5167	5167	5167	5167	5167	5167	5167	5167	5167	5167	5167		
Vet medicine	180	213	425	425	425	425	425	425	425	425	425	425	425	425	425		
Suppl. Feed	2295	2106	2106	2106	2106	2106	2106	2106	2106	2106	2106	2106	2106	2106	2106		
Taxes	864	579	653	898	1797	1797	1797	1797	1797	1797	1797	1797	1797	1797	1797		
Total Outflow	4739	8802	9338	10496	11394	11394	11394	11394	11394	11394	11394	11394	11394	11394	11394		
Net benefit before financing																	
Total	3274	-4636	-3811	-2513	5572	5572	6572	6572	6572	6572	6572	6572	6572	6572	6572	62602	
Without Project	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	2852	42786	
Incremental	422	-7489	-6663	-5365	2719	2719	3719	3719	3719	3719	3719	3719	3719	3719	3719	19816	**1321**
Financing																	
Investment Grant	2250																
Total	2672	-7489	-6663	-5365	2719	2719	3719	3719	3719	3719	3719	3719	3719	3719	3719	22066	**-1396**
Discounted net benefit (Discount Rate = 1)																	
	2672	-7132	-6044	-4635	2237	2131	2775	2643	2517	2397	2283	2175	2071	1972	1878	9942	**0.08**

Cost effectiveness analysis

An economic cost-effectiveness analysis was carried out in order to ascertain the validity of the proposed programme as compared with alternative investment options that may yield similar environmental benefits, i.e a forested, currently degraded, pasture with native species. The comparison of the two senarios is based on discounted cash flows. It is assumed that the reconverted pasture would have lower bio-diversity benefits but higher amounts of carbon sequestered.

Variables

In this scenario an alternative investment is the reforestation with native species (*Terminalia amazonia, Dipteryx panamensis, Hieronyma alchomeoides, Calophyllum brasiliense, Vochisia guatemalensis, V. ferruginea, Swietenia macrophylla, Tectonia grandis and Gmelina arborea*). For the 70 ha forest plantation the land need to be purchased. The objective of the plantation is to sell mature standing trees for wood.

Establishment costs include land preparation and fire prevention measures.

Maintenance costs include labour and materials: Maintenace costs decrease gradually during the first 4 years to reach equilibrium at the 5th year.
Average time to reach maturity of native especies: 27 years (Range: 12 - 40 years).
Average volume m^3/ha at maturity: 200.
Average growth m^3/year: 7.407.
Percentage of the biomass as carbon (on dry basis): 45.
Cummulative growth ton: total biomass = biomass m^3/ha x wood density ton/m^3.
Wood density (average por native species): 0.6 ton/m^3.
Fencing: 100 US$/ha.
Cost of Land : 250 US$/ha.
Soil and non wood biomass calculated as 1.5 times wood biomass.
Price of wood for the farmers in the region (standing trees): 16 US$/ton.

The analysis is presented in the following table.

Table annex 4c.2: Cost effectiveness analysis

	Years																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Land Value or Compensation																											
	17500																										
Establishment Costs																											
	34020																										
Fencing																											
	7000																										
Maintenance Costs																											
		16310	9170	5950	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110
Total Costs																											
	58520	16310	9170	5950	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110	5110
Annual Growth m3 wood																											
	0	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519
Annual Growth tons wood																											
	0	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311
Cummulative Growth ton in Wood																											
	0	311	622	933	1244	1556	1867	2178	2489	2800	3111	3422	3733	4044	4356	4667	4978	5289	5600	5911	6222	6533	6844	7156	7467	7778	8089
Cummulative under ground and non wood biomass																											
		467	933	1400	1867	2333	2800	3267	3733	4200	4667	5133	5600	6067	6533	7000	7467	7933	8400	8867	9333	9800	10267	10733	11200	11667	12133
Cumulative Carbon sequestration ton																											
	0	350	700	1050	1400	1750	2100	2450	2800	3150	3500	3850	4200	4550	4900	5250	5600	5950	6300	6650	7000	7350	7700	8050	8400	8750	9100
Sale of wood (US$16/ton)																											145600
Total costs of sequestring 1 ton of carbon																											8.48

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Institutional Analysis

A. Project implementing agencies

COLOMBIA - CENTRE FOR RESEARCH ON SUSTAINABLE AGRICULTURAL PRODUCTION SYSTEMS (CIPAV)

CIPAV is an organisation recognised for its scientific and technological excellence, made up of a network of agricultural enterprises and a group of small farmer families, associated with qualified researchers who provide their knowledge for the solution of concrete problems. It is permanently in contact with several groups, research centres, institutions and companies that encourage rural sustainable development throughout Colombia and various countries in Latin America, Asia, Africa, Europe and the United States. CIPAV's institutional mission is to contribute to sustainable development through research, training, and communication related to production systems appropriate for tropical agro-ecosystems.

The objectives of the organisation are (i) To design, investigate and validate agricultural systems, which contribute to sustainable rural development: (ii) To train small farmers, agricultural entrepreneurs, technicians and professionals; and (iii) To disseminate the results of the research on appropriate technologies to farmers, institutions and organisations.

Work areas

Research, design and validation of technology

CIPAV's early work focused on validation of technologies developed in countries like Mexico, Dominican Republic, Cuba, Australia, India and Bangladesh, related to the use of sugar cane and by-products of the sugar and panela (brown sugar loaf) industries, harvest residues, non conventional protein sources and organic wastes, and the direct transfer to small and medium-sized farmers, and agro-industries in the Cauca Valley. With farmers collaborating as co-researchers or associate researchers, CIPAV has developed sustainable agricultural production systems upon this basis.

This approach was broadened to include the design of new technologies that fit the specific environmental, social and economic conditions of small and medium farmers. Basic, applied and participatory researches are increasingly important for the institution. Based on technologies appropriate for the tropical resources, CIPAV contributes to the generation of systems suitable to the potentialities and social and environmental needs of these countries.

Training

In order to disseminate the ideas and principles related to sustainable agricultural systems, CIPAV has developed different types of training activities that include tutorships, research scholarships, thesis, courses, seminars, workshops, teleconferences and others. The work with small farmer communities involves a training process through a diagnosis of the social, economic and environmental reality of the zone; the analysis of farming systems, agricultural topics, conservation, human and animal nutrition, and the conception and elaboration of projects. The traditional empirical understanding is combined with modern scientific and technological knowledge in the identification of the opportunities offered by the local resources. Non-formal training processes

have evolved into the current communication models between small farmers, with the participation of leaders (women, men, adults and youngsters) who disseminate the ideas and technological innovations in a suitable language.

In 1992, an agreement between the Javeriana University, CIPAV and the Mayor Campesino Institute enabled the creation of an MSc program on Sustainable Development of Agricultural Systems In the country and abroad, CIPAV contributes to several initiatives of undergraduate and postgraduate professional training, oriented towards rural development and sustainable production systems.

Communication

The training and communication tasks of CIPAV are strengthened through international seminars and workshops, important opportunities for the exchange of knowledge with other researchers. A large number of publications are aimed at different publics; these include scientific articles in international indexed journals, books, manuals, booklets and CD-ROMs, as well as videos and TV programs.

Electronic media are an important part of our communication strategy. *Livestock Research for Rural Development*, an electronic journal that serves as a means of communication between researchers of the tropical and subtropical countries, completed ten years of continuous publication in 1998. LRRD was the first specialised electronic publication in the world. CIPAV has its own Internet web-site and collaborates with FAO through electronic teleconferences for Latin America and the rest of the world.

Scientific bases of farming systems promoted by CIPAV

CIPAV's experience in different ecosystems can be summarised in a strategy for sustainable agricultural production in the tropics, based on the following principles:

- Closing the nutrient cycles within farming systems. Conservation and efficient recycling of organic matter are strongly emphasised as a way to stimulate the biological activity of the soil.
- Promotion of perennial mixed farming rather than short cycle crops and homogeneous plantations. Trees, especially nitrogen fixing species, are included in all production subsystems, from horticulture to livestock production.
- Increase biomass production. A portion of pastures is replaced with crops for human nutrition and highly productive forage species. Harvest residues are used to protect soils against superficial runoff and to enhance their structure.
- Encouragement of biodiversity within farming systems. Structural and taxonomic diversity within agricultural systems are encouraged in order to increase the combined production of crops and stimulate biological control of plagues. Planting herbaceous plants, shrubs and trees in multiple layers contributes to efficient nutrient cycling and soil stability while providing support for several bird and arthropod species.
- Reduction of the use of external supplies, such as pesticides, fertilisers and commercial animal feedstuffs. These are slowly replaced by local or regional resources, thus decreasing production costs and environmental impact.
- Elimination of common practice of burning vegetation (crops, pastures, and harvest residues), thus enabling the use of biomass in the maintenance of soil coverage, and avoiding carbon emissions to the atmosphere.
- Promotion of efficient use, recycling and decontamination of water through biological methods. Aquatic plants cultivated in small channels are used to remove organic pollutants, as part of a system that generates useful by-products such as green manure, high fertility mud and animal feed.
- Decreasing the cost of agricultural activities and the dependence on loans, and take advantage of household, local or regional manual labour.
- Reduction of the size of the area required for productive activities. Through efficient agricultural production within smaller areas, fragile lands can be used for conservation or restoration of natural ecosystems.
- Promotion of the use of renewable energy sources such as biogas, animal draught and firewood, and reduce dependence on fossil fuels.

- Integration of plant and livestock production through forage crops and use of manure.
- Strengthening of family-level food security and the sale of healthy products in local markets.

The participatory application of these principles in farms and small farmer communities contributes to the recovery of traditional knowledge and the enhancement of life quality through a healthy and balanced diet. At the same time, permanent learning is encouraged and profits increased through products that have a higher value in the market. Indirect effects include a reduction in youth migration to the cities or toward illegal activities, a reduction of pressure on forests and facilitation of the ecological recovery of degraded areas. In farms and medium or big agricultural or agroindustrial enterprises, these principles can favour the efficient use of the available resources and thus decrease production costs significantly, improve the quality of products for sale and generate rural jobs.

Components of systems encouraged by CIPAV

- Sugar cane: whole cane, tops, bagasse, juice
- Industrial sub-products: sugar mill molasses, cachaza (first froth on sugar cane juice when boiled) and panela molasses, palm oil products, liquor industry yeast, concentrated residues from the liquor industry (vinaza)
- Harvest residues: amonification and hydrolysis of fibrous residues (sugar cane, rice, beans), by-products of cotton oil extraction.
- Silvopastoral systems: Live fencing, wind-protection shields, biological corridors and shade for animals; Managed succession within silvopastoral systems; Intensive systems for cattle and other animal species: High arboreal density silvopastoral systems; Cut and carry systems.
- Non conventional protein sources: forage trees and shrubs: *Gliricidia sepium, Trichanthera gigantea, Morus spp, Alocasia macrorhiza, Boehmeria nivea, Malvaviscus penduliflorus, Erythrina edulis, Tithonia diversifolia, Erythrina fusca, Erythrina poeppigiana*, and aquatic plants: *Azolla spp, Lemna minor, Salvinia natans, Pistia stratoides, Eichornia crassipes.*
- Nitrogen-rich supplements for ruminants: multi-nutritional blocks, organic residues, and liquid urea and molasses mixtures.
- Use of biodiversity: orchards for human and animal food security in small farms (up to 35 species interacting in the place).

Integrated production systems

- Dual-purpose bovine livestock.
- Restricted suckling in bovine cattle.
- Animal draught with female bovines and buffaloes.
- Rotational pasturing of pregnant sows.
- Continuous-flow plastic biodigesters.
- Biological systems for productive decontamination of water.
- Productive reforestation with forage and woody species.
- Weed control through pasturing of African sheep controlled by shepherd dogs.
- Recycling of animal manure through biodigestion, vermiculture, compostage and irrigation.
- Minimal tilling, green manure and coverage for soil protection.
- Multiple-layer agroforestry systems.
- Pigs (breeding, raising and fattening) and poultry for small farming systems.
- Vegetation recovery: management of succession, agroforestry systems, free-ranging pigs as a tool for reforestation.

Achievements

- More than 10,000 people - small farmers, entrepreneurs, students, professionals, technicians, indigenous people and researchers from over 30 countries- have seen the results of our work in the field. Between 1997 and 1998, 1458 people participated in both national and international training events sponsored or co-ordinated by CIPAV.

- In 1998 the Productive Decontamination System developed by CIPAV was recognised by the United Nations and FAO as a technological innovation for developing countries.
- Integrated systems developed by CIPAV produce up to ten times more meat and milk per area unit than extensive livestock traditional systems, with environmental benefits such as conservation of soil, water and a considerable portion of the biological diversity.
- CIPAV's research has contributed to the knowledge on more than ten tree and shrub forage species that allow the diversification and improvement of tropical livestock systems.
- Intensive systems designed by CIPAV enable landowners to set aside fragile or marginal lands for nature conservation or ecological restoration.
- CIPAV's main asset is its human team, a research group associated with entrepreneurs and small farmers consolidated and recognised at a national and global level.

Awards

- National Ecology Award - Planeta Azul 1995.
- Colciencias (Colombian Institute for Science and Technology) Certification as a Scientific Excellence Centre 1996, 1998.
- Certified by Colciencias as A category Scientific Excellence Centre 1999.
- Environmental Grant by Andina de Herramientas S.A. and Cooper Tools 2000.
- Admited as Member Organisation of the International Foundation for Science 2000.

COSTA RICA - CENTRO AGRONÓMICO TROPICAL DE INVESTIGACIÓN Y ENSEÑANZA (CATIE)

CATIE is an international, non-profit civil association that conducts research, education and outreach activities in agricultural sciences, forest management and biodiversity conservation, agroforestry systems and watersheds, socioeconomics and related subjects on natural resources management throughout Latin America, with an emphasis on Central America and the Caribbean. CATIE's mission is to alleviate poverty and increase human well-being by applying research and teaching towards the conservation and sustainable use of natural resources in Tropical America. Due to its active research, outreach and training program and its close relations to many research and academic institutions, CATIE is a leader of natural resource management and conservation in the region.

In the field of livestock, CATIE has a silvopastoral systems unit, focusing on the development of environmental friendly livestock production systems for the Latin American region. The main priority of this unit is the recovery of degraded pasturelands. CATIE has conducted novel research in selecting multi-purpose trees and improved grasses for improving the productivity of livestock production systems. Over the past years, research in silvopastoral systems have been focused on the contribution of pastures and trees to increasing productivity and income of farms, and providing additional benefits including sequestration of carbon in silvopastoral systems, soil improvement and conservation of biodiversity. Most of the research is done through Ph.D. and MSc students from CATIE's postgraduate school. A socio-economic evaluation on these systems is being conducted to determine how carbon benefits will offset capital investment for establishing these systems and how they will contribute to adoption of improved technologies.

The technical co-ordinator of the project (CATIE) would be Dr. Muhammad Ibrahim (Area of Watershed Management and Agroforestry Systems), an expert in silvopastoral systems and livestock production systems, who has been working in CATIE for more than 8 years. Dr. Ibrahim and his postgraduate students have conducted research on silvopastoral systems and carbon sequestration in Central America since 1995 and have produced more than 15 research papers on the sustainable management of livestock production systems. Dr. Ibrahim's knowledge of the area and its agricultural systems would facilitate the implementation of project activities and ensure that project activities are tailored to local conditions. Dr. Ibrahim is currently supervising the field work of one Ph.D. and two MSc students in the proposed project areas on the socio-economic evaluation of the livestock production systems, and local knowledge of farmers regarding trees in silvopastoral systems. Dr. Ibrahim is also supervising research in these areas of studies in Nicaragua, Belize, Honduras, Colombia and

Panama.

The technical advisory committee of the project would include:

- Dr. Markku Kanninen (Research Director, CATIE), a forester and specialist in studies on environmental services in forestry systems. Dr. Kanninen is currently leading a project on land use changes and carbon sequestration in Central America, which is funded by the climate change program in Finland. At present, Dr. Kanninen is directing two Ph.D. theses, on modelling of carbon sequestration and 4 postgraduate students who are currently working on environmental services. He is also a leading a group on carbon sequestration
- Mr. Kees Prins (Area of Economics and Sociology), a specialist in rural development, participatory methods and gender issues. Mr. Prins has more than twenty years of experience working with rural communities in Latin America and would assist in the socioeconomic diagnostics and the preparation/orientation of training and outreach events, to ensure that all stakeholders are included in the project activities.
- Dr. Mario Piedra (Area of Economics and Sociology), a specialist in marketing, economic development in rural communities and econometrics. Mr. Piedra would be responsible for conducting the socio-economic analysis to determine how different socio-economic variables (i.e. prices for meat, milk, timber, labour; labour availability, capital, demand for animal products, changes in land use tenure, migration of farmers, leakage etc; incentives for environmental benefits etc). affects farmer's decisions regarding the adoption of the new technologies, as an input into the policies for paying and monitoring environmental incentives.

The advisory committee (and technical co-ordinator) would participate in the design, co-ordination and implementation of all projects activities, including training and outreach events.

NICARAGUA-NITLAPAN

The Organisation, Activities & Current Situation

Nitlapán (which means, "time to sow" in the indigenous Nahuatl language), is the Institute of Research and Development of the University of Central America (UCA), a Jesuit university located in Managua, Nicaragua. Over the past decade, Nitlapán has developed an innovative, multi faceted approach to reactivating the economy and society of Nicaragua. Its focus is rural economic development. Its principle tools are micro-finance, applied research, and development. Nitlapán has prepared approaches to diagnose and address the vicious cycle of undercapitalization, environmental degradation and lack of technical information in rural areas. In the process, it is succeeding in integrating practical strategies of environmental recovery in its development programs.

Nitlapán is highly regarded both within Nicaragua and abroad. Its reputation as a professional, ethical, apolitical and non-ideological organisation has won respect and trust from current and former administrations and credibility along the political spectrum. Grant and investments have come from donors in the United States and Europe, including the MacArthur and Ford foundations, Oxfam and Intermon. Nitlapán plays a critical role in helping rural families get back on their feet as well as in institutionalising a rural finance system that incorporates modern, ecologically sensitive practices.

NITLAPÁN Strategies

Nitlapán´s pursues its rural development mission through three main activities:

- Applied Research is Nitlapan's original focus, from which its other programs have emerged. Among the country's most respected analysts of the needs of the country's rural populace, its studies have focused on identifying the opportunities and constraints facing landless peasants, co-operatives, and smallholders (small ranch owners). This research has led to new approaches to some of Nicaragua's major socio-economic challenges—helping farmers gain land titles, diversifying agricultural production in an ecologically sustainable way, promoting reforestation, and improving rural access to financial services (a particular need since the dismantling of the state development bank last year). In recent years, its applied research programs

have deepened the country's understanding of the rural sector by sponsoring seminars and publishing articles on subjects as diverse as the Nicaraguan coffee industry, effective reforestation, basic grains production, demand for and provision of savings and other financial services to build self-sufficiency.

- The Development Program has a three-fold focus: (i) "Trees are Precious" (Los Arboles Valen) uses credit and technical assistance to teach smallholders to plant trees for diversification, income and ecological sustainability. (ii) "Capitalization Programs" assist smallholders to build equity in their land by obtaining land titles, diversifying production and planting "living fences" to reduce erosion; and (iii) an extension service which provides a range of advice and technical assistance to smallholders in commercial forestry and crop diversification, legal issues, and income-supplementing activities, such as handicrafts and furniture production.

- The Fund for Local Development (FDL) is Nitlapán´s micro-finance arm, and the leading micro-lender in Nicaragua. It fills the void created by the absence of conventional rural finance in the country (see below).

Fund for Local Development (FDL)

Nitlapan's credit activities, called the Fund for Local Development (FDL), was established nine years ago. During 1998 FDL had over $4 million outstanding to nearly 5,000 borrowers, making Nitlapán one of the most active and well-established non-conventional financial intermediaries in Nicaragua. FDL focuses on rural areas in the Pacific and Central regions of the country. Credit recipients include subsistence farmers (28% of outstanding), small landholders (42%), and farmers/ranchers (30%). FDL lends from a wide range of productive activities, including farming and livestock (52%), small industry (4%), trade (30%), and services (14%). This is reflected in the maturity distribution of its credits, with 37% at less than one year, nearly 50% between one and two years, and the remainder at over two years. FDL operates in 8 departments of the country (including 4 of those hardest hit by Mitch) out of 16 branches.

There has been a substantial improvement in the quality of FDL's portfolio as it has put new emphasis on professional development of staff, improved MIS systems, and financial accountability for branches. Delinquent loans dropped from nearly 16% of the outstanding portfolio in 1995 to under 3% in 1997. In a recent assessment of the Nicaraguan microfinance industry conducted by PAMIC, a government and donor supported think tank, Nitlapán was ranked first out of thirteen microfinance NGOs on a composite rating of impact, financial structure and operating performance. Nitlapán received a perfect score in measures of outreach and market penetration, with outstanding performance in terms of growth in loans to the target population and numbers of clients.

In addition to its strong performance as a financial intermediary serving the low- income rural sector through FDL, Nitlapán has also built a reputation for intellectual rigor, unquestioned ethics, and lack of ideological or political agenda. It has also used its position to advance the interests of the rural population, as well as the non-conventional intermediaries serving this sector, through seminars, publications and promotion of industry associations, most recently as a founding member of ASOMIF, the Association of Nicaraguan Microfinance Organisations.

ASOMIF – the Association of Nicaraguan Microfinance Organisations -- was formed in July 1998 at a meeting of twelve NGOs sponsored by the Swedish International Development Agency (ASDI) and facilitated by a representative of Shorebank Corporation, a leading U.S. development finance institution with substantial international experience.

Research and development activities

NITLAPAN has employed five technical workers who are directly involved in conducting applied research to

improve farm productivity and livelihood of livestock farmers. Mr. Carlos Barrios who holds an MSc in the field of Agroforestry and has more than 10 years research experience in the evaluation of farm productivity would be responsible to co-ordinate the activities in workpackage 2. Carlos barrios has been involved in designing novel methodologies for financing rural credits for livestock farms which are currently being used by rural banks in Nicaragua. He is also involved in research focused on the integration of multi-purpose trees in silvopastoral systems to increase fodder supply in the dry season and the evaluation of timber trees in silvopastoral systems.

Some current research projects in agroforestry include

- Utilisation of fodder trees and shrubs for feeding cattle during the dry season
- Quantification of fruit and litter production of fodder trees in pastures during the dry season
- Ecological factors that affect survival and growth of timber species in silvopastoral systems in different ecological zones of Nicaragua.
- Carbon sequestration in pasture/silvopastoral systems
- Integration of commercial timber species in pastures.
- Developing credit systems for farmers to promote of adoption of silvopastoral technologies

B. Project partners

LIVESTOCK, ENVIRONMENT AND DEVELOPMENT (LEAD) INITIATIVE

The LEAD (Livestock, Environment And Development) Initiative is an inter-institutional project with the secretariat in the Food and Agriculture Organization, FAO. This initiative is supported by the World Bank (WB), the European Union (EU), the Ministère de la Cooperation (France), German Federal Ministry for Economic Cooperation and Development via GTZ (Germany), the Department for International Development (United Kingdom), the US Agency for International Development (USA), the Danish Institute for Development Assistance (DANIDA, Denmark), the Swiss Agency for Development and Cooperation (Switzerland), the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), The International Livestock Research Institute (ILRI) and FAO.

The work of the initiative targets at the protection and enhancement of natural resources as affected by livestock production and processing while alleviating poverty. LEAD has identified, at a global scale, the consequences of increased pressure on grazing and mixed farming systems and the dangers of the shift to industrial modes of production. It highlighted the close interaction between government policies and the environmental impact of livestock production, and showed the large number of technologies, which are available to mitigate the negative effects in all different production modes, provided the appropriate policy framework is in place. Subsequently, the initiative mobilised funding for critical follow-up needs. In particular:

- To improve communication and enhance the relevance of research and development issues regarding livestock-environment interactions, by establishing a Virtual Centre for Research and Development in Livestock Environment Interaction. This Virtual Centre promotes multidisciplinary research and development activities and increases awareness among key stakeholders of the complex interactions of human needs, animal production and the sustainability of global natural resources. The Virtual Centre operates both globally (based at FAO, Rome) and through French- and Spanish speaking language platform, hosted by partner institutions(CIRAD and CATIE, respectively).
- To conduct a series of pilot research and development projects in key areas of livestock-environment interactions, most notably in livestock-wildlife integration, livestock-associated deforestation and the establishment of area-wide integration of specialised crop and livestock activities.
- To develop specific tools to facilitate decision-making on livestock-environment issues, designed to adapt general principles of improved management of livestock environment interactions to the special regional needs and conditions.
- To facilitate the policy dialogue at country level and to provide assistance in policy formulation and

incorporating novel concepts at various decision-making levels for the "mainstreaming" of livestock-environment issues within the context of overall economic and social development.

AMERICAN BIRD CONSERVANCY (ABC)

American Bird Conservancy (ABC) is a not-for-profit Organisation dedicated to the conservation of wild birds and their habitats in the Americas. The fundamental role of ABC is to build coalitions of conservation groups, scientists, and members of the public, to tackle key bird priorities using the best resources available. ABC has offices in Washington D.C. and The Plains, Virginia, and staff in Colorado, Montana, and Oregon.

ABC is a leader in Partners in Flight (PIF). PIF is a multinational initiative to integrate existing bird conservation needs and programs into a single, comprehensive plan for protecting all birds in North America. A diverse array of more than 200 non-profits, government agencies, forest product companies, colleges, and universities participate in PIF. ABC's Important Bird Areas program is a central aspect of PIF and involves hundreds of volunteers and other conservation groups in a nation-wide effort to identify and enhance protection for the most important sites for bird conservation in the U.S.

ABC's Policy Council, composed of 75 groups, complements the PIF network. The goal of the Policy Council is to draw everyone interested in and working on policy issues affecting bird conservation together to implement collaborative strategies. The Policy Council meets regularly and ABC publishes a newsletter Bird Calls which contains updates on key policy issues affecting birds.

ABC's International Program provides north - south links among conservation groups throughout the Western Hemisphere through the Conservation Counterparts program and annually supports more than a dozen field projects in Latin America and the Caribbean.

ABC's new program on Climate Change is investigating how bird distributions may be altered as Earth warms. The program is supported by the Environmental Protection Agency which will use the information to help plan a response to the problem.

ABC's Cats Indoors! Campaign seeks to inform cat owners, decision makers, and the general public that free-roaming cats are a significant threat to birds and other wildlife, pose a threat to humans, and often live short, painful lives. The campaign is working to secure the humane removal of free-roaming cats from sensitive wildlife areas, and to persuade cat owners to keep their cats indoors. ABC together with The Humane Society of the United States and the American Humane Association, developed a brochure, education kit, and poster for use by more than 1000 groups across the country participating in the campaign.

ABC is a membership organisation and derives support from individual memberships, foundations, corporations, organisations, and government sources. Members receive ABC's quarterly magazine, Bird Conservation and the Policy Council newsletter, Bird Calls, which is produced three times a year. ABC is also the sponsor of the revolutionary new field guide, All the Birds of North America.

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Scientific Background to Environmental Benefits of Silvopastoral Systems

Project Rational

Despite the considerable efforts to reduce the destruction of natural habitats and the resulting decrease of wildlife populations in Latin America, the beginning of the new century does not look more promising for biodiversity conservation than the preceding years. Classical approaches to conservation, attempting to preserve pristine habitats ' within National Parks and other protected areas, have failed both in scale and in acknowledging the dynamics of the local communities. Driven by a variety of social and economic pressures, local settlers continue their expansion into the last remnants of native forests, and in many cases the prevailing land use patterns are both inefficient from an economic perspective and environmentally harmful.

Throughout Latin America, landscape transformation is dominated by the establishment of open rangeland for livestock production, irrespective of the characteristics of soils, climate regimes, and topography. Pasturelands occupy the largest proportion of the agricultural lands in the region, and to a large extent, their profitability is insufficient to sustain human populations. At the same time, the environmental impacts resulting from this indiscriminate form of land use are damaging, and responsible for many of the current threats to biodiversity conservation in the Neotropics. From this standpoint, it is urgent to find alternatives to livestock production in Latin America that, while helping people to improve their living conditions, reduce negative impacts on nature and even restore to some extent unpaired environmental services. The development of alternative technologies is promising in this respect. Multi-purpose farming and agroforestry practices applied to livestock production enterprises open new avenues for linking sound agricultural development and conservation.

Cattle production and the environment

Cattle production in Latin America has been associated with deforestation. For example, about 38 percent (94 million out of 248 million hectares) of Central America's total land area is used as permanent pasture. Land used for extensive grazing has increased continuously over the past decades and most of this increase has been at the expense of forest. Tropical forests still cover almost 70 million ha (FAO, 1999) and contain a large fraction of the world's biodiversity, as many animal and plant species are unique to this area. Ranching-induced deforestation is one of the main causes of loss of some unique plant and animal species in the tropical rainforests of Central America and South America. In the past, government-backed conversion of forest to other land uses as large scale ranching was one of the leading causes of deforestation. Today poverty, joblessness and inequitable land distribution is forcing many landless peasants to clear the forest for subsistence farming. The decline in productivity and the lack of appropriate technologies in the agricultural frontier force many small farmers to sell the cleared land to livestock farmers.

While there is rapid deforestation (17 million ha/year globally, FAO 1994), ruminant livestock production has expanded with only modest productivity growth. The prevailing grazing systems are mainly based on native grassland, with no or only limited integration with crops. These systems often do not involve external inputs. In the humid areas, forest and savannah clearing to establish pastures causes soil nutrients to leach out rapidly. Weeds displace grasses, and artificial pastures can only be sustained for a period of up to ten years. In Central America, large pasture areas have now been abandoned because of degradation. Natural regeneration of forests is quite difficult; especially where cleared areas are large. Traditional livestock systems are often marginal in an economic sense and follow land use practices that are not considered sustainable in the long term. In particular this applies to cattle production in tropical hillsides and areas of forest margins. It is estimated that more than 40%

of tropical pastures are in an advanced stage of degradation.

Livestock grazing systems occupy a significant proportion of the agricultural lands throughout much of Latin America. Ranching includes a variety of systems established in different types of soil, vegetation and climate. Since landscape transformation caused by livestock grazing encompasses such a wide variety of practices, its environmental impacts can also be widely diverse (Murgueitio 1999). It is important to recognise that impacts are both direct and indirect, and that associated processes cause many of the environmental problems adding their effects to those caused by the conversion to pastureland itself. The intensity of direct impacts depends both on the type of grazing system, as well as on the characteristics of local ecosystems. These differences have not been fully evaluated, so the general picture of wholesale destruction of natural biota is a composite of many local, specific impacts.

Apart from deforestation and fragmentation of habitats, the conventional cattle production system in the region has been associated with other environmental impacts such as erosion, soil compaction, losses of genetic diversity, demand for wood and water and soil contamination. Finally, livestock and other sources of deforestation also results in one fourth of global C02 emissions to the atmosphere, contributing to climate change, and to biodiversity losses in natural forests. Increasing isolation of the remnants of natural forest amid a homogeneous cultural landscape further increases the negative effects of the dominant forms of livestock grazing the Neotropics. Socially, conventional cattle raising has also been associated with an unfair distribution of resources (land, wealth and knowledge) and lack of opportunity for the rural sector. Cattle production in the tropics is facing new challenges especially the balance between food supply and conservation goals. This requires a new policy framework with an understanding of human and environment needs.

Socio-economic problems linked to livestock grazing

Many Latin American countries in which most deforested lands are converted to pastures, experience deep social crises characterised by violence, unfair distribution of resources, and lack of opportunities for the rural sector. The diversity of situations, involved citizens, and environmental impacts of ranching must be recognised in order to transform the current systems into activities compatible with socio-economic development and the protection of nature. In Latin America, cattle raising can be divided in two broad classes (i) systems in which the cattle business constitute the main economic activity; and (ii) those in which land speculation is the basis of the economic enterprise.

The urgent need to transform tropical cattle raising is evident. Political change in agrarian structures is required as well as technological alternatives for those truly interested in cattle as a means of production. Researchers, decision-makers, technicians and farmers must admit that a higher biological potential exists and that it can be reached if nature is wisely managed understanding the limits of each ecosystem, and if cattle raising is integrated with other production systems. Many of these systems require technological and entrepreneurial change in order to reduce negative impacts on soil, water and native vegetation. Alternative systems for raising cattle must be intensified through the intelligent use of local resources (natural and human) adapted to each agro-ecosystem. In this context, environmental services include attractive conditions for ecotourism, watershed protection for the production of more and cleaner water, conservation of forests and biodiversity, habitats for wildlife and carbon sequestration. A range of environmentally beneficial cattle production systems are emerging as a synthesis based on both old, proven ideas and a new understanding of natural nutrient cycles and ecosystems. Recent research has shown that local and global environmental services can be provided by silvopastoral systems.

Alternative grazing regimes in Latin America

Several systems of alternative ranching have been recently developed in the Neotropics. These systems, which represent a substantial part of the ongoing transformation of the land-use patterns in the region, can be grouped in three major categories (Murgueitio 1999):

- Forest plantations with livestock grazing: In the tropical lowlands, some plantations of fine wood have as the

main associated cost the invasion by different grasses (both native and exotics). Recently, this situation has been managed by introducing cattle, which has resulted in the livestock paying for much of the management costs of the plantations (Londoño 1996).

- Live fencing, wind-protection shields, biological corridors and shade for animals: This system, widely used in some countries of tropical America, utilises fast growing trees and shrubs that not only provide an inexpensive alternative for fencing, but also supplements the diet of the livestock. In some cases, the system develops into actual biological corridors connecting remnants of the original forests through a network crossing the agricultural lands. Naturally, the importance of living fences as corridors increases with size, structural complexity and plant species diversity.
- Intensive systems for cattle and other animal species: Intensive systems for cattle and other livestock (reducing the amount of land required for ranching thus freeing some areas for natural forest regeneration or for agroforestry), are perhaps the most promising alternatives to extensive grazing. Because of environmental problems and increased production costs, intensive grazing is now approached in 2 radically different way using high densities of tree and shrubs used by livestock as a diet supplement while protecting the soil from compaction an erosion. There are two types:

  a) High arboreal density silvopastoral systems: Because of environmental problems and increased production costs, intensive grazing is now approached in a radically different way using high densities of trees and shrubs used by livestock as a diet supplement while protecting the soil from packing and erosion.

  b) Cut and carry systems: Replace grazing in open pasturelands with stables in which livestock is fed with the foliage of different trees and shrubs specifically planted in areas formerly used for other agricultural practices. This system is particularly successful in Central America for raising goat (Benavides 1994), and in Colombia for a variety of animals including cattle, horses, goats, sheep, water buffalo, rabbits, guinea pigs, and poultry.

Environmental services of silvopastoral systems

Silvopastoral systems are a type of replacement vegetation, which to a large extent mimics forest ecosystems. They provide a deeply rooting, perennial vegetation which is persistently growing and which have a dense but uneven canopy. Silvopastoral systems are an alternative to prevalent cattle production in Latin America and have the potential to produce environmental services and improve people's livelihoods.

Carbon sequestration

Between 1850 and 1985, land use in Latin America generated an emission of carbon to the atmosphere of ca. 30 Pg (Houghton et a., 1991). This emission has been related to the increase of land covered by pastures. According to Veldkamp (1993), low production pasturelands on the Atlantic slope of Costa Rica caused a net loss of organic carbon from the soil ranging between 1.5 Mg/ha and 21. Mg/ha.

However, silvopastoral systems are capable of fixing significant amounts of carbon in the soil under the improved pastures and in the standing tree biomass (wood). Fisher *et al.* (1994), identified a substantial sink of carbon in pastures based on deep-rooted grasses which have been introduced in the South American savannahs. According to the authors, deep-rooted grasses in this part of the world have the potential to sequester as much as 100-507 Mt organic carbon per year deep in the soil. In this study, the authors measured soil carbon including fine roots, in improved savannahs of the perennial grasses *Andropogon gayanus* and *Brachiaria humidicola* associated with the legumes *Stylosanthes capitata* and *Arachis pintoi* respectively, *B. humidicola* alone and they compared them with savannah in Colombia. Results showed that all the grass-based pastures made a striking contribution to soil carbon compared to the native savannah, especially when grown with a legume (legumes contributed with 20% to root biomass and increased substantially carbon sequestration). Compared with the savannah, the grass-based pastures sequester most of the carbon in the deeper part of the soil profile (this is between 40 and 100 cm depth). This carbon should therefore be less prone to oxidation, and hence loss. The rooting depth of different species and their combinations is therefore a major factor to take into account for estimations of carbon sequestration. The study of Fisher et al. (1994) showed that in all cases, carbon soil contents were lower in the layer between 20 and 40 cm depth than deeper in the soil. This trend was also evidenced by Beinroth *et al.* (1996). In their study of

factors determining carbon sequestration in tropical soils, they found that for all soils, organic carbon content decreased at depths between 20 and 50 cm and increased below that layer.

Research by CIPAV in Colombia has shown that there are higher carbon contents in soil under silvopastoral systems (Ramirez, 1997). Research conducted by CATIE (2000) in Panama and Costa Rica showed that silvopastoral systems can sequester more carbon in the soil (due to the increased growth of the pasture in the association with legume trees) and in addition, an important fraction of the carbon is sequestered by trees in the form of wood.

Table annex 6.1: Carbon dynamics in a grass monoculture an silvopastoral systems in acid soils, Panama

System	1994	1996	1998
	Tons Carbon/ha		
Brachiaria humidicola (improved pasture)			
Soil	28.3	48.1	65.2
B.humidicola/Acacia mangium (Silvopastoral system)			
Soil	29.9	53.2	71.9
Trees (only trunk hard wood)	0	6	13.6
Total	29.9	59.2	85.5

Source: CATIE, 2000

Biodiversity conservation

Forest conversion into pastures threatens the survival of many species, and therefore is considered as a priority subject for conservationists (Serrao & Toledo 1990; Szott et al., 2000). When pastures are used for a short period (< 5 years) and then abandoned, forest regeneration is very rapid as compared to those situations in which pastures have been used for more than 12 years. Boundaries between degraded pastures and both second growth and primary forests are often very sharp, resulting in biodiversity losses (Wiens 1992). In recent years, ranchers have started to manage silvopastoral systems in order to increase the productivity of their lands while promoting the conservation of natural resources (Ibrahim & Schlonvoigt 1999). In Central America, isolated trees are a common feature within silvopasture. Recent studies indicate that these trees play a major role in the survival of wildlife species by providing scarce resources and refuge (Harvey & Haber 1999).

It has also been shown that seed drop under trees within pastures is larger than in open grasslands, and that there is a higher propagation rate of native forest plants under these scattered trees (Harvey & Haber 1999). In Monteverde (Costa Rica), 190 forest plant species were found within 240 ha of pastures used for dairy production. These trees and shrubs are mainly used as shade for grazing animals, wind screens, and to provide wood for fencing, fuel, food, and shelter for wild birds (Harvey & Haber 1999). In the Pacific lowlands of Costa Rica, traditional silvopastoral systems contain a variety of trees that provide fodder for the livestock during the dry season in addition to timber for fuel and fencing. Farmers promote the growth of these trees to diversify their income sources (Beer et al. 2000). Many Costa Rican ranchers are using fruiting trees to attract charismatic bird species aiming to develop the ecotourism potential of their lands.

Living fences and wind screens are man made habitats modified over time by the driving forces of plant succession. Species composition depends on local ecological conditions, and the original preferences of the farmers, and not necessarily on the nature of the forest seed bank. Connectivity provided by a series of living fences affects the movement of wild animals between natural habitats, and facilitates seed dispersal (Burel 1996). Therefore, this kind of fencing can actually serve as a biological corridor in agricultural landscapes characterised by the fragmentation of the natural habitats. In some ranches small patches of native forest are left untouched to act as wind shields, to protect watersheds, or to be used as sources of timber for fencing (Guindon 1996, Harvey & Haber 1999). In Monteverde (Costa Rica), 25% of the estimated 400 species of birds have been found within wind shields placed in pastures of dairy farms. Birds were the most important agents of seed dispersal, especially when the wind screens were connected with the native forests. Undoubtedly, silvopastoral systems provide significant support to the conservation of forest plants and wildlife within this agricultural landscape (Harvey &

Haber 1999).

Food availability for wild birds is high in silvopastoral systems, and the complex structure of the vegetation provides more adequate nesting substrate and better protection against predators than other agro-ecosystems. In addition, several authors have noted that both silvopastures and other agroforestry systems harbour a larger and more complex assemblage of invertebrates (50-90%) than monocultural pastures, which explains the diverse bird communities found within (Dennis et al., 1996). It has been pointed out that bird frugivores inhabiting secondary forests do not fly very far into abandoned pastures, which results in seed dispersal restricted to an area of 9-80 m surrounding scattered trees close to the forest edge. Recent expansion of secondary forests within ranches is likely to enhance forest seed dispersal into abandoned pastures, further increasing the connectivity between different elements of the forested landscape (wind screens, living fences, scattered trees, forest remnants, etc.). At the regional level, silvopastoral systems may play an important role in the implementation of the Mesoamerican Biological Corridor, given the vast coverage of pasturelands in Central America. It is expected that these corridors will provide adequate habitat for wildlife while facilitating seed dispersal and the regeneration of the native vegetation (Saunders & Hobbs 1991).

Wild birds in Latin American pasturelands

Because the original plant cover throughout most of the Neotropics was dominated by different kinds of forests, habitat transformation into open grasslands undoubtedly had a tremendous impact on local biota. In those areas of Latin America where human settlements have been transforming the landscape for centuries, the few remaining patches of forest have an impoverished biota as compared to those in more remote areas much of the original fauna and flora persists thanks in part to the connectivity provided by a more heterogeneous landscape.

Judging from very raw estimates of bird species richness in the region, a negligible proportion of the original avifauna can survive in degraded agricultural systems (Stotz et al., 1996). However, depending on the original habitat considered, agro-ecosystems can support a substantial proportion of the original avifauna. This is particularly striking for grasslands (campo, low seasonally wet, southern temperate and northern temperate), where more than one fourth of the local avifaunas regularly use the agro-ecosystems. The proportion of migratory species using agro-ecosystems is somewhat larger, perhaps as a consequence of their less specific habitat requirements. This is particularly striking for those species that occupy open habitats during their breeding season, and so are able to use man-made habitats during non breeding seasons. The proportion of breeding birds of natural grasslands using agricultural landscapes represented by Nearctic migrants, ranges from 64 to 100% (based on statistics from Stotz et al., 1996). Local variation of bird diversity in agricultural landscapes may depend on the particular type of agricultural practice on a given area, as has been widely demonstrated for shade coffee plantations in different parts of the Neotropics. This a factor that deserves attention when evaluating the potential of other land-use patterns in the region, as is the case for livestock grazing.

In an open range pastureland in the Cauca River Valley of Colombia, Naranjo (1992) found that of 141 species of birds occurring in the region where the study site was located, 42 were counted during censuses in pastureland, and only 14 regularly used this habitat. However, Cárdenas (1998) found that silvopastoral systems in another locality of the same valley support a significantly larger number of bird species than open pastureland with very low densities of trees and shrubs. Eighty-nine out of 135 bird species used the agro-ecosystems and of these, 51 were found breeding within these habitats.

Table annex 6.2: Richness and diversity of birds in different agro-ecological systems in the Cauca Valle

System	Species	Diversity Index
Fruit crops	57	3.21
Silvopastoral systems	46	3.07
Improved pastures	43	2.98
Dry forest	33	2.86
Organic sugarcane production	33	2.43
Bamboo forest	29	2.73
Conventional sugarcane production	19	1.53

Source: Cárdenas, 1999.

In addition, recent information on neotropical migrants using silvopastures suggest that these systems have a high potential for bird conservation: Greenberg et al. (1997) discovered that managed patches of *Acacia pennatula* in southeastern Mexico supported both the highest density and diversity of migratory birds compared to other habitats in the region, and also, the highest numbers of more than one half of the common migratory species. In general terms, monocultural pasturelands harbour a lower species diversity than silvopastures, second growth, and primary forests. In the Brazilian Amazon, it has been found that activity of frugivorous birds is more intense (movement between habitats) between secondary forests and multi-layered pastures, as compared to that between the forest and active monocultural pastures of *Brachiaria brizantha.* The presence of scattered trees within the pastures was responsible for 70% of the observed movements between the patches of secondary forest and the pastures (da Silva et al., 1996).

Table annex 6.3: Movements by frugivorous birds between a secondary forest and pastures in Amazonian Brazil .

Movements from secondary forest to	*Rainy Season*	*Dry Season*
Multi-species grass lands [1]	263	113
Pasture monoculture[2]	15	6

[1] includes grasses, shrubs, and low density trees
[2] Brachiara brizantha
Source: Adapted from da Silva et al, 1996.

Habitat Connectivity and Biodiversity (birds)

Despite the fact that in the three countries considered in the proposal there are a number of protected areas, the lack of connectivity among them precludes full protection of species that require large areas to maintain viable populations. Open grasslands separating protected areas and unprotected remnants of natural forests act as a barrier for many species and the interruption of gene flow among relict populations severely impair the chances of the survival in the long term. In this respect, the creation of complex agricultural mosaics provides an opportunity to connect landscape elements in such a way as to facilitate the movements of native birds to and from the remnant patches of natural habitats.

Among all the wild species native to tropical forests, some bird taxa are particularly sensitive to habitat fragmentation and lack of connectivity. Species with large home ranges such as raptors and large frugivores are good examples of these limitations, and therefore their protection indirectly benefits a large number of other taxa, including plants, invertebrates and other vertebrates. The concept of "umbrella" species is widely used nowadays in planning conservation projects, and any improvement in the conditions for the survival of these organisms will undoubtedly result in the maintenance of overall species richness, genetic diversity, and ecological functions at the landscape scale.

In addition to the importance of land use practices which promote habitat connectivity for native tropical birds

and other organisms, the design of conservation projects in productive systems also result in benefits for non resident species. Migratory birds nesting in North America spend a substantial part of their life cycles in the Neotropics and in many cases have habitat requirements similar to those of native species. It has been demonstrated that the maintenance of heterogeneous habitats in Latin America is of the utmost importance for migratory birds, which depend on tree and shrub cover as a refuge and mainly as foraging substrate. Along the Central American flyway as well as in the northern Andes, the replacement of natural forests by homogeneous agricultural landscapes is considered one of the major threats to many North American birds. For this reason, the implementation of silvopastoral systems in Nicaragua, Costa Rica and Colombia would add to other ongoing efforts to protect these birds.

In the following paragraphs, a summary of the bird conservation scenario at each of the areas included in this proposal is presented.

Nicaragua

According to the most recent checklist of Nicaraguan birds (Martínez-Sánchez 2000), 544 species have been recorded in the country. Even though no geo-political endemics occur in Nicaragua, the avifauna of the country includes many species with relatively small geographic ranges and therefore highly vulnerable to the destruction and fragmentation of their natural habitats. These include two globally threatened species, the Keel-billed Motmot (*Electron carinatum*) and the Neotropical migrant Golden-cheeked Warbler (*Dendroica chrysoparia*) (Collar et al. 1992).

Because of the long history of habitat transformation for agricultural purposes, the area where this project would operate in Nicaragua does not harbor many species sensitive to deforestation. However, the area is part of the buffer zone of the Natural Reserve Cerro Musún and very close to one of the priority areas for bird conservation in the country according to The Nature Conservancy Wings of the Americas Program: this hot spot, located at ca. 12°15' N and 85°15' W, is considered important for the conservation of 6 bird species of special concern, including birds with large home ranges such as the Crested Eagle (*Morphnus guianensis*), and Central American specialties such as the Snowcap (*Microchera albocoronata*). The improvement op arboreal cover in the region would expand suitable habitat for some of these species and facilitate gene flow among remnants of natural vegetation.

Costa Rica

Among Central American countries, Costa Rica is considered particularly rich in terms of bird diversity. More than 840 species have been recorded to date (Stiles and Skutch 1989), including 200 Neotropical migrants and 7 endemic species. Thanks to the number of National Parks and Reserves in the country, many of these species have some protection; the IUCN Red Data Book (Collar *et al.* 1992) lists four threatened species for Costa Rica, including the Bare-necked Umbrella bird (*Cephalopterus glabricollis*).

Many forest species recorded in Costa Rica are altitudinal migrants, thus requiring a range of habitat types during their annual cycle. For this reason, habitat connectivity is extremely important for their conservation, as well as for the maintenance of the ecological processes of which they are part. The increase of heterogeneity in agricultural landscapes at both sites included in this proposal would play a major role in this respect. On the one hand, the proximity of the sites to conservation areas such as La Fortuna Region, the Monteverde Reserve Complex, and the Alberto Brenes Biological Reserve would help the chances of survival of several species occurring in these protected areas. In addition, two of the areas considered to be a priority for bird conservation in the country according to The Nature Conservancy Wings of the Americas Program are in close proximity to the proposed sites (10° 30' N and 84° 45', 10° 15' N and 84° 5'). With enhanced protection measures, these areas can protect at least 52 species of conservation concern including the Great Currasow (*Crax rubra*) and the Three-wattled Umbrella bird (*Procnias tricaruncula ta*).

Colombia

One of the features that distinguish Colombia as a megadiverse country is its worldwide famous bird fauna: about 1800 species have been recorded to date, including more than 150 Neotropical migrants. The Andean region harbors a substantial part of this richness, despite the severe habitat degradation and wholesale deforestation prevalent in many areas. However, many species are considered as globally threatened or at least, highly vulnerable: according to Collar *et al.* (1992), 55 species are threatened to some degree, including 30 of the 65 geo-political endemics.

The foothills of the Central Andes, where this project would operate, are one of the most severely degraded regions in the country from a conservation point of view. Most of the protected areas in the region are at higher elevations, and the few remnants of natural habitats in the foothills are mostly unconnected. It is therefore urgent to implement some actions to restore habitat heterogeneity and connectivity in order to increase the chances of survival of species requiring large home ranges. The proposed sites lie at the core of many of the areas considered as a priority for bird conservation in Colombia: for instance, one of such areas included in TNC's Wings for the Americas Program, if protected, will help to preserve 37 species of concern, including endemics such as the Cauca Guan (*Penelope perspicax*), the Chestnut Wood-quail (*Odontophorus hyperythrus*), and the Red-bellied Grackle (*Hypopyrrhus pyrohypogaster*).

Other environmental benefits

There are many other potential environmental benefits of silvopastoral systems:

- They can improve water infiltration and be used for watershed management. Water holding capacity increases with the presence of trees, which results in better water cycles, and consequently, in the conservation or improvement of water sources. Although it may even be better precipitation, area-wide, with the presence of forest cover, the presence of shrubs and trees shifts the rainwater flux from superficial runoff, with considerable soil erosion, to more water infiltration, greater soil retention and greater and more permanent springs and water courses.

- Soil retention (prevention of landslides). In hilly areas, trees have an additional protective role in the ecosystem, that of preventing landslides. Not only is the presence of trees essential for soil protection on slopes, but also the variety of species is important. Trees of different root depths are required for effective soil anchorage, in particular in those events of torrential rains accompanying tropical storms, which seem to become more frequent in recent years in many parts of the world.

- Improvement of soil productivity: increases nutrient re-cycling across a deep portion of the soil profile occupied by the root systems of a wide variety of plants associated of silvopastoral systems. Depending on the species of trees being used, and on local mil characteristics, trees extract water and nutrients from soil horizons inaccessible to grasses, and deposit them on the ground with the natural fall of foliage, twigs, and fruits. The biomass and amount of nutrients released by pruning the trees of the agroforestry systems varies depending on the kind of management in use. Nonetheless, it is known that up to 18 tons of dry matter/ha/year can be deposited on the ground and that the amount of nitrogen flowing through the system reaches values of up to 380 kg/ha/year in agroforestry settings (Alpizar et al.1983).

- Sparing fossil fuels. Silvopastoral systems spare fossil fuels in various ways: a) Shrub and tree legumes fix atmospheric nitrogen and thus replace energetically (fossil fuel) costly inorganic nitrogen fertilisers that otherwise would be applied to pastures. b) Silvopastoral systems improve feed quality, quantity and seasonal distribution throughout the year, and consequently there is less need for supplementation with concentrates. In general terms, cereal-based concentrates coming from intensive production are very costly from the point of view of fossil fuel inputs. c) Life-fences and other trees present in forage banks and pastures, are sources of

firewood for rural or urban use, directly replacing fossil fuel.

- Reduce emissions: Indirect reduction of the emission of greenhouse gases caused by deforestation and shifting agriculture.

- Other benefits of silvopastoral systems. The presence of trees potentially brings additional benefits to farms:
- Diversification of farm products. Bee honey, fruits and wood (round wood, firewood & posts) are additional products that can be marketed when silvopastoral systems are established in farms. The economic value of these would vary depending on their demand and the distance from markets.
    - Beautification of landscape. A farm with trees is no only more beautiful but also more appealing to potential agro-tourists.
    - Land rehabilitation. Under certain circumstances, the present value of land can be substantially increased when trees have been planted, and this can be in itself, the main incentive for reforestation.

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Monitoring and evaluation plan

Monitoring of biological and socio economical trends would be assured by the monitoring programs included in the baseline course of action as well as by the methods that would be established by the alternative. Monitoring results and conclusions reached as a result of evaluation reports would be used to recommend and implement changes in project management and for future reference in the development of similar or related projects.

Monitoring land use changes for global environmental services

The land use changes would be determined through direct measurement in a sample of the farms, with an extrapolation to all the participant farms on the basis of changes in the vegetation and landscape characteristics. The focus would be on the definition of stable carbon. It would follow the following steps:

- *Creation of database of farms selected:* A database would be created for each farms which include biophysical data:

  - Land use system (traditional and improved pastures, silvopastoral systems secondary and primary forest).
  - Geographic distribution of systems.
  - Soil conditions and topography: type, fertility, physical aspects, slope.
  - Management: fire, grazing etc.

- *Calibration of incremental carbon in different land use systems:* About 10 to 15% of farms inscribed in the program would be selected to monitor changes in carbon in time and to develop equations and indicators to estimate incremental carbon. The criteria for selecting farms would include:

  - Representativeness of livestock production system in the area.
  - Land use: pasture, silvopastoral systems and forest systems.
  - Farmers willingness to collaborate in the establishment of permanent plots.
  - Farm access

On each farm, carbon would be monitored in the different land use systems and the data would be used to estimate the relationship between landscape changes and incremental carbon. This relationship would then be used to estimate carbon increments in the rest of farms inscribed in the project. In the following table is a list of indicators and methodology that would be used for monitoring carbon in each of the land use system that are common in livestock farms.

Table annex 7.1: Indicators and methodology for monitoring carbon in different systems.

System	Indicator	Methodology
Pasture	Root biomass and density at different soil levels.	BOTANAL, dry weight rank method, root coring
Trees dispersed in pastures	Growth Volume Tree density Roots	Measurement of diameter at breast height and total height, develop equations to predict carbon Inventory Root coring
Secondary forest	Aerial biomass Density of species Roots	Harvest and weigh biomass of each component, age, root coring, establish equations
Plantation	Growth Volume Roots	Measurement in diameter at breast height, total height, root coring, establish equations
Trees in living fences and borderlines	Growth Yield, density/km	Measurement of diameter at breast height and total height

Methodology for estimate carbon: In each farm selected permanent plots would be established (using GPS) to first establish data on baseline carbon of each farm and then to monitor annual changes in incremental carbon. The estimations of carbon would be carried out for the following sources: above ground biomass (timber) and soil (different depths).

Carbon in above ground biomass: In order to monitor carbon sequestered by trees, temporary plots would be established which have a circular shape and varies according to the productions systems. In the case of line planting, linear plots would be established.

Table annex 7.2:Plot size for monitoring carbon in different production systems.

System	Plot size		
	Radius (m)	Area (m2)	Length (m)
Silvopastoral system (dispersed trees)	15	706.9	
Plantations	10	314.2	
Secondary forest and fodder banks	5	78.5	
Trees in line planting			30

Source: Adapted from MacDiken 1997.

In each farm a plot would be established for each of the systems identified.

Localization of plots: In the first sampling date, a representative area in each farm would be selected using sampling techniques developed by CATIE. The co-ordinates of each plot would be determined using a GPS and entered in the data base for each farm. From the central point, a measuring tape would be extended to mark the radius of the plots. Once the plot size has been established, data would be collected on abundance and dynamics of trees, diameter at breast height, total height etc Diameter would be measured with a breast height measuring tape and height with a graduated measuring rod. Height would also be calculated. The volume of timber and or biomass would be estimated based on allometric equations developed for each species. In case that these equations do not exist for a given species, sampling would be carried out to develop the equations.

Constructing allometric equations: An allometric equation for each or a group of species would be constructed in the absence of secondary information. The population of a given species would be divided in 4 to 5 diameter classes (depending on the variability) and 4 to 5 individuals of each diameter class would select to take data on

diameter at breast height, total height, crown area, and commercial volume. Plants would then be harvested to quantify Dry matter biomass: trunk, branches y leaves).

Soil carbon

Soil carbon would be determined at different depths using a soil auger. The depths are: 0 –20, 20-40 and 40 – 100 cm. Samples collected would be air dried and analyzed in the laboratory for carbon using method of Walkley-Black. A sample would be taken in each depth on bulk density which would be used to adjust soil carbon based on bulk density of the soil. based on the value of bulk density, organic carbon would be estimated.

Monitoring Biodiversity in the Target Areas

Because of the complexity of monitoring all the components of biodiversity in all the sites of the pilot projects of the three countries, the project would concentrate on two specific indicators. In order to document the changes in vegetation cover and connectivity during the implementation of the project, first the spatial component at the landscape level would be assessed, by carrying out an initial description of the major habitats present at each region. To evaluate the impact of these habitat changes on the local biota, changes in composition and abundance of birds would be monitored as indicators of the taxonomic component of biodiversity. The reason for choosing birds as an indicator is justified by the following considerata:

- Birds are a well-known group, and therefore the uncertainty of taxonomic identification is eliminated almost completely. Identification of birds at the species level is possible in the field, and an examination of how representative is the recorded avifauna is possible by comparison with existing databases and literature sources.

- Because of the wide range of ecological functions performed by birds, this group provides an insight into the ecological dynamics of the agro-ecosystems. A healthy community of birds indicates that ecological processes such as pollination, seed dispersal and tropic relations are maintained within the spatial scale chosen for the project.

- Standardized field procedures for monitoring bird populations and communities are available, and therefore the information gathered during the project would be comparable with similar studies for other regions and/or extrapolated for similar geographic and physiographic settings.

Habitat descriptions: The major components of the landscape would be identified, geo-referenced, and described. The descriptions would include:

- A general floristic assessment at each sampling plot for carbon sequestration. A circular plot would be set (radius according to production system see carbon monitoring), and all plants with a DBH equal to or larger than 2 cm would be counted and identified at least at the generic level. A standard vegetation profile for each landscape unit would be produced, determining the different vegetation strata and relative covers of each plant identified in the previous exercise. Based on the numbers of individual plants and their projected perpendicular cover, relative frequencies and abundance would be estimated to determine dominance and specific associations. Tree and shrub diversity would be estimated based on the abundance of each species using the Shannon-Wiener index.

- Each habitat thus characterized would be assigned a specific graphic code to be used in a layer of the GIS built for each region. Initial area of each habitat would be estimated, and the spatial relationships among every pair of habitats would be established. This information would be the baseline to evaluate the changes in vegetation cover during the implementation of the project. New measurements would be taken once every year, and the dates and locations of all major land management procedures would be duly recorded. Management practices to increase connectivity between habitats would be encouraged in addition to the silvopastures, and advise to the farmers to facilitate such procedures would be provided both by the

implementing agencies and the researchers carrying out biodiversity monitoring.

Bird Monitoring: Given the small size of the farms chosen for the pilot projects in the three countries, it would be very unlikely to establish an adequate number of sampling plots for each representative habitat within the agricultural landscape at every farm. For this reason, and aiming to assess the impact of the proposed land conversion on the local biota, it was agreed by all partners to carry out the initial assessment of the indicator group (birds) and monitoring changes in composition and abundance of individual species at the landscape level.

After the major landscape components are identified and described, a number of census plots would be established at each following the recommendations made by Reynolds *et al.* (1987). Each census plot would be located on the maps of the area using a GPS, and marked permanently to insure that the observers would carry out the censuses at the same spots at every sampling. Census plots would be circular, with a radius varying between 10 and 40 m depending on the vegetation cover of each particular habitat. In order to avoid as much as possible counting the same birds more than once, census plots would be at least 100 m apart.

Censuses would be carried out monthly at every plot. A census route would be established to cover the plots in sequence, and in order to avoid timing biases at least two counts would be made every month in reverse order. Each particular count would start immediately after sunrise, and last until 9 a.m. Since the number of count plots is likely to be too large to be covered in a single day, the census route would be divided in segments to be covered in several days. As in the case of plot sequences, the order in which the different segments are visited during each census would be changed every month to avoid biases caused by fixed timing.

During the censuses, the observers would remain at each plot for 10 min, recording all the birds observed and heard within the radius of the plot. All birds recorded would be identified to the species level, and their number, specific location within the habitat, and activity would be noted. Those birds seen or heard outside the census plots would also be recorded in a separate data sheet to complement the inventory of the study area.

Since a local research assistant would be hired for each study area, after initial training by the biodiversity technician the assistant would be responsible for carrying out opportunistic observations between monthly censuses. Besides keeping a log of these observations, the local assistant would also record the location of bird nests and inform the technician of all reproductive activity in the study area. Each nest would be marked to allow mapping by the technician, and tracked periodically to determine reproductive success.

Data analysis

Landscape analysis: Annual variation in plant cover would be determined from the habitat descriptions, and quantified for each farm within each region. Connectivity would also be measured, and the number of vegetation strata within each study plot would be compared over time. This information would be used as predictor of bird richness and diversity, and would also be used to make decisions regarding the contributions of each farmer to overall habitat enhancement as a basis for the biodiversity prize.

Bird data: Quantitative data recorded during the censuses would be used to make comparisons of abundance and diversity between the different landscape units, as well as to examine within habitat variations over time. In addition to these statistical analyses, a cluster analysis of all the census plots would be carried out at the end of each year to identify those landscape components supporting the most diverse avifaunas. This analysis would enable to make specific recommendations for habitat management within the farms, as well as for landscape management and design for the entire region.

The total list of species recorded both during the censuses and the opportunistic surveys would be compared with the hypothetical bird list for each region by means of the Komar index. This index weighs the number of species of special concern (endemic, threatened and endangered species) and allows the identification of those habitats more important from a conservation perspective. As in the previous analysis, these results would enable the preparation of specific recommendations for management, and to identify which agroforestry practices are most

useful to improve habitat for local biodiversity.

Monitoring Water Quality In Watersheds Using Biological Indicators

Generally speaking, water quality is defined considering three aspects: (i) The concentrations, species and types of organic and inorganic substances present in the water' (ii) The composition and state of the aquatic biota; and (iii) The temporal and spatial changes which are produced given the intrinsic and extrinsic factors of the aquatic system under study. The methods of water quality determination based on biological parameters are characterized by their simplicity and speed, they also have the advantage that they are able to show how conditions where some time before the samples where taken. The macro-invertebrates recovered are identified by their family and are correlated with the Hellawell index which gives values to groups of families and gives a particular classification of the quality of water.

A representative section of the water body under study is selected. Four to five evenly spaced points are chosen, and at each point a five to ten meter transect is manually trawled with a Surber net and sieves to obtain a sample of the fauna. For a period of 30 minutes all the organisms which are present en in substrates present (what, mud, leaves, stones) are collected. This work is complemented with an analysis of physiochemical and bacteriological parameters. The variables which are used for the evaluation of water quality are: Dissolved Oxygen, TSS (Total suspended solids), Sedimentable Solids, BOD (Biological Oxygen Demand), Nitrates, Phosphates, Turbidity, Temperature, pH, Fecal Coliforms, Total Coliforms. The samples are refrigerated until they can be analyzed.

At the same time, data is recorded in the field about the state of the river banks in terms of vegetation, associated fauna, state of ground cover, local populations, farms and houses. Based on this information the streams are mapped and the possible effects on the samples are marked. Samples are made monthly during six months, continuing the monitoring annually for the three years. Organisms in the field are identified with the support of the co-researches and they are classified according to taxonomic class. The organisms which cannot be identified are taken to the laboratory for their later identification with the help of taxonomic keys and stereoscopes. The samples are preserved in 70% alcohol. Once all the organisms are identified the biotic indexes are applied for each sampling point, these include: Trent biotic index, Chandler index (richness and abundance), index of diversity, Hellawell index (adapted to the tropics).

Community involvement: The young co-researchers are selected in each zone for the monitoring. Once the organisms have been identified they would be in charge of making educational material to continue the work and to help the design of environmental education programs.

Monitoring Socio-Economic and Land Use Changes

A monitoring system would be established to determine how payments for environmental services affects farmers decision in terms of land use (*i.e*. natural and improved pasture, silvopastoral systems, secondary and forest plantations) to benefit from environmental services, technological adoption, use of labor and on farms productivity. The land use models that were developed by REPOSA (Wageningen Agricultural University) would be adapted to study: 1) the impact of different land use changes on carbon sequestration and biodiversity at a farm and landscape level; 2) the effect of adoption of technologies affects on productivity; 3) the effect of changes in prices for animal products, timber and carbon sequestration on farmers decision in land use, 4) the effect of the adoption of technologies on labor use; and 5) leakage in land use to be assessed with the use of GIS data base. This methodology is based on an integrated systems-analysis and consider all aspects of cattle production systems (pastures, herds, and feed supplements). Tools that would be used include an expert systems, dynamic simulation modeling and linear programming techniques. A cattle production system consist of four components: i). herd generating marketable product and characterized by feed requirements; ii) pasture supplying feed and characterized by sustainability indicators; iii) feed supplements and; iv) additional products (timber, environmental services etc.). An expert system called PASTOR (Pasture and livestock Technical coefficient generator) (Bouman *et al.*, 1998) would be used to compute input and output technical coefficients for a number of alternatives for each of these components. Alternatives are based on production levels and management

technology. PASTOR was extended to compute sustainability indicators for the alternative pastures (improved grass legume mixtures, fodder banks, trees dispersed in pastures). Linear programming (LP) would used as a tool to quantify the economic viability of the whole cattle production system. The LP model maximizes economic surplus by combining selected alternatives from each of the three sub-systems based on their technical coefficients. The scenarios that would be modeled would include: prices of carbon (stored in the soil and timber); price changes in meat, milk and timber; labor availability and price; labor demand, land prices; discount rates; incentives from carbon sequestration; management; trade-offs between carbon sequestration and emissions of other gasses (methane, N_2O and NO).

Geographical Information System and Remote Sensing Component

In essence, GIS is a data base management system (DBMS) specifically designed for simultaneous processing of spatial and related attribute data. In addition to DBMS, GIS also has many capabilities similar to automated map making, computer-assisted cartography and computer graphics systems. The ultimate use of GIS lies in its capability for modeling: constructing models of the real world from digital data bases, and using these models to simulate the effect of a specific process over time for a given scenario.

In the framework of the project, this ability would be particularly used to:

- Calculate the areas concerned with the pastures improvement, in order to pay the environmental services.
- Assess the biodiversity improvement through the localization of field observations, and their comparison to existing geographical databases. The assessment of Landscape changes would also be used as a proxy for biodiversity.
- Monitor land use changes to track how the farmers would shift from traditional / extensive systems to more intensive silvopastoral systems. This would possibly lead to the modelisation of land use changes in order to upscale the projects outputs for decision support in policy formulation. Support complementary analysis such as risk of fires and encroachment.

Activities

Aerial surveys would be proceeded at the beginning and the end of the project. This would allow (i) to get two accurate pictures of the farms and check the ground observation that would be made with help of GPS, and (ii) to localize the farms on the biodiversity and land use maps that already exists. The photos would be made by local companies in the three countries, and processed by CATIE. During the project, the assessment of field areas changes, biodiversity, water-system quality would be done using GPS and GIS software by each of the three institutions. To insure the quality of this data acquisition, the field teams would be trained at CATIE, with support of an international consultant.

The analysis of the geographical data would be done by CATIE, with support of FAO. This would be done in close co-operation with the organizations in charge of the monitoring activities and of the policy component, to insure the best use of GIS abilities.

Multi-Criteria Evaluation Of Policies

A matrix would be constructed showing the distribution of benefits from goods and services of different pasture, silvopastoral, agroforestry and forestry land-use systems at three different levels: 1) landowner; 2) local community and 3) country. This matrix would be adjusted for this study from the one presented by Segura *et al.* (1997). The construction of this matrix would be based on discussions about the expectations and needs of landowners, local leaders, national livestock and forest policy makers and international experts, primarily related to the case studies already selected.

As a second step, the pasture, silvopastoral, forestry and agroforestry land-use systems to be evaluated would be selected and described. Next and as a tool for this evaluation, a set of criteria and indicators would be develop to

enable the assessment of those respective land use systems, in terms of their contribution for satisfying landowner, local and national needs previously identified. This set of criteria and indicators would be reviewed by other experts representing various disciplines, and it would also be discussed with the policy makers. The valuation (assessment) of the indicators would be carried out in two steps: a) analyzing the information produced from the CO_2 modeling and GIS results, and b) these results would reviewed by the project staff, other experts, and policy makers.

The next step would be the integration of the valuation of the indicators in a way that it facilitates the interpretation by policy makers. For the analysis of these results, fuzzy logic mathematics that allows the analysis of data from vagueness and uncertainty responses (Bandemer and Nather, 1992) are being used by CATIE. The integration of the final results is being considered two ways: a matrix that shows the final results for each indicator and land-use system, and a "Sustainability Triangle" which shows the contribution of each land-use system for the bio-physical, economic and social dimensions. This integration of results would help to assess possible discrepancies between what is the optimum for the livestock landowners, local and national levels. The hypothesis is that expectations and priorities would be different at different levels. For example, landowners and local interests might prefer to maximize income, provide employment, reduce risks from land-use activities, and at the same time protect local watersheds. The interest at the national livestock and forest policy level might be broader in terms of social and economic interests, reduction of the trade balance deficit, and the general contribution to the national GDP. The above methodology is based on a recent research project that CATIE undertook in collaboration with the Center for International Forestry Research (CIFOR) (Campos and Orates, 1999).

Policy linkages

The project team would identify a target group of policy makers in the 3 countries through direct contact and through a questionnaire. The members of the target group would represent governmental institutions, private sector and NGOs working with the policy formulation on livestock, forests and climate change. In addition, regional organizations, such as the Central American Commission for Sustainable Development (CCAD) would be invited to participate. The target group would participate in the project through an interactive mechanism. The results of these activities would be translated into policy terms and meetings would be held with the target group in order to present them with policy choices.

Project Evaluation Plan

CATIE would monitor project objectives, outcomes, and activities using logframe indicators presented in the project summary. In addition, performance benchmarks are being developed to complement the overall project indicators presented in the project summary that would provide the basis for the Bank's disbursement of GEF funds throughout the project. In each country the local project coordinator and financial project manager would be responsible for constant monitoring and evaluation to determine the success of project administration. Project technical and financial implementation reports would be completed every six months to meet both project requirements and internal planning and evaluation schedules. Project accounts would be monitored and evaluated by a regular financial audits by a certified accountant. Selected programs of stakeholder consultation, training, and capacity building would include evaluation sessions using instruments such as questionnaires, group evaluation forms, and open discussions. Special reports would be completed as necessary. The Steering Committee of the project would meet at least once a year in and would serve as an expert panel of advisors/evaluators. Monitoring results and conclusions reached as a result of evaluation reports would be used to recommend and implement changes in project management and for future reference in the development of similar or related projects.

Annex 8

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Social Assessment

The social assessment (SA) and participatory consultations have been practically completed for the project. Spanish versions of the working documents are available in the project files. As part of the appraisal process, more attention would be given to elaborating the poverty profile of the direct beneficiaries. This annex provides a brief summary of the general socio-economic profile of the areas in the three project countries. It describes poverty levels, resources use, and local organization structure. In the project areas there are no indigenous communities, the entire population consists of recently settled mestizos. The project therefore does not involve any resettlement or other indigenous peoples issues.

Background

The process of social assessment and participation comprised an analysis of existing information, provided by the executing agencies, local NGOs and World Bank's countries profiles. It has been complemented by local consultations as well as further studies and fieldwork carried out by the local executing NGOs, that have been working in the project areas for over ten years.

The primary beneficiaries of the enhanced eco-systems management provided by the project are the rural communities and rural producers living in the project areas. The social organization of the target populations differ by country and zone. The population generally consists of small campesinos and medium sized ranchers, who manage livestock production systems that could play an important role in sustainable ecosystem management. In order to adequately consider the social, cultural and economic diversity of the population groups of the three countries, the social assessment is organized by country.

Therefore, in each country, the social assessment process has essentially entailed the following activities:

1) *Identification of key stakeholders in the project area:* The primary beneficiaries of this project are rural communities and rural producers.

2) *Identification of key social issues* in ecosystem management in the project areas. At least five key issues have been identified during the preparation process and would be subject of further analysis:

- The need to consider the project area as a living space, not a conservation space
- The relationship between local culture and the environment
- Land tenure and distribution
- Economic activities
- Social organization

3) *Assessing the potential social impacts* of the project, with special focus on gender.

COLOMBIA: Valle del Cauca y Quindio Region

Socio-economic profile

Poverty

Social indicators, as determined by public services coverage, housing quality, dependency and other livelihood characteristics, grouped in the international index of Unsatisfied Basic Needs (UBN) prove the severe poverty of a high percentage of the people of the project area. Even more importantly, the balance between the urban and rural sectors is heavily skewed towards the urban population. For example, while the average share of the population with UBN in 1993 for the total region in the Cauca Valley Department is 25 percent, there is only 23 percent with UBN in the urban sector, while in the rural sector this figure is 35 percent. This skewed equity between the urban and rural areas is a strong additional force that promotes rural to urban drift especially of young people. The movement from the rural to the urban zone was a process of the last 50 years because of the political violence of the fifties, and the industrialization and the development of the agro-industry in the flat zones in the eighties.

Natural resources use

The two project areas have the most densely populated areas in the Cauca Valley and Quindio departments. They are dedicated mainly to commercial, industrial, manufacture and agro-industrial activities. Sugarcane and coffee are the most important agro-industries of the region, with an export tradition of more than two centuries for the sugarcane and nearly one century for the coffee. Other important crops in the two departments are banana, vegetables (in high zones) and in a lower proportion tubers (cassava and potato), oil crops (soy beans) and cereals (maize and sorghum). The contribution of cattle to the regional economy seems insignificant (one percent) but its importance lies in the high occupancy of degraded land, its potential for providing ecological services and its potential role in the development of organic agriculture and silviculture. Because of settlement, indigenous ethnocidium, colonisation and development of the ranches - first of the colonial type and later agro-exporter (sugar and coffee) - land tenure was determined more than two centuries ago in most of the Cauca river valley and since the early nineteen hundreds for the foothill of the central Andes. The colonisation of the coffee region was based on private property at the family level, so in this region most of the land is in private hands and completely legalised.

Social Issue. Violence.

Cauca Valley and Quindio departments face serious security problems because of armed insurrection, paramilitary forces and common delinquency. These three activities are directly or indirectly financed by drug traffic money. The skewed equity, displacement of communities, lack of labor opportunities, low coverage and poor quality of basic services are strong incentives for the illegal activities, especially those derived from drug-traffic and armed insurrection. The zone of the project has been selected taking into account these risk factors. The high mountain zones were therefore discarded. even if livestock systems in those higher altitudes are more than 90 percent of the agricultural frontier and could be used for the environmental service of water quality improvement for intensive agriculture and urban populations. The selected corridor between the foothills of the central Andes in the Quindio and Cauca Valley provides reasonable conditions of security.

Direct Beneficiaries

- Two hundred forty five families related to the 70 pilot farms (owners and permanent workers) would receive TA, inputs, training.

Indirect Beneficiaries

- Two hundred eighties families would get additional work for the establishment of the silvopastoral systems
- Sixty public official of the Regional Autonomous Corporations would be trained in environmentally friendly livestock systems
- Five microenterprises would have higher supply of bamboo (procured in the farms)

- Fifteen families would be selling higher fuelwood production for commercial purposes

- Forty young people would be trained in water quality monitoring

NICARAGUA: Rio Blanco and Matigua Municipalities

Socioeconomic profile

Poverty

The two project Municipalities rank respectively 20 and 29 (out of 160) in the classification of the poorest Municipalities of Nicaragua, and more than 50 percent of the people do not have their basic needs covered (water, education, health, housing).

Use of natural resources: agricultural systems.

Most eventual project participants practice extensive livestock, but for the smaller farms agriculture activities become important parts in the livelihood of the family. Most of the fincas are of small to medium size. The traditional system ("slash and burn": *roza-tumba-quema*), and its post-deforested variant (*roza-quema*) prevails. The project region represent the "old agriculture frontier", in fact the first settlers arrived more than 30 years ago.

Social organization

Although this was one of the zones most affected by the war, the security situation is now satisfactory, with no conflict related to land tenure (the land issued by the agriculture reform has been legalized). Nitlapan is developing a network of producers for training and the provision of technical assistance according to the "campesino a campesino" i.e farmer to farmer model.

Direct Beneficiaries

- Hundred eighty families of small and medium size producers would have access to TA on silvopastoral systems, initial investment grants to improve the management of the farm and payment for environmental services.

Indirect Beneficiaries

- Three hundred fifty small and medium size farmers would benefit indirectly, with knowledge of the systems that are being promoted through the demonstration effect of training events, farmer to farmer contact, and establishment of improved systems.

- Three hundred workers would have better knowledge of the systems by indirect participation in training events, circulation of leaflets and through farmer-worker means of communication.

- Three hundred rural families would benefit indirectly with a source of employment on the farms on which technologies would be established, as the labor requirements are greater for the silvopastoral systems promoted by the project.

- Fifteen families of local assistants would be contracted to participate in training events and technical assistance on different aspects related to management of livestock and silvopastoral systems.

- Operators of Agricultural services would benefit through the demand for seed material and other inputs and services.

Affected

The introduction of improved technologies, eliminating the need for slash and burn agriculture would directly affect the poor, small campesinos, that are practicing agriculture activities on the land left by the producer as fallow. The environmental educational campaign would also affect poor people that were using fire for hunting These hunters and landless could be hired by the producers, since the labor requirements are higher for silvopastoral systems compared to extensive livestock systems.

COSTA RICA: La Fortuna y la Esparza Regions

Socio-economic profiles of the focal zones

Poverty

In the Northern Huetar Region which covers La Fortuna, the monthly per capita profit is one of lowest of the country: 20.855 colons, in contrast with the Central Region: 35.232 colons. The poverty index of the region is 26.3 percent, higher than all country (20.6 percent). The literacy of the young population is very high, close to 100 percent of the young population and 70 percent of the adults have completed primary education. Small and medium farms prevail in the region. More than 90 percent of small cattle farmers have land titles.

Agriculture and Livestock Production.

The first settlers arrived to this region in the thirties, where they practiced slash and burn agriculture, to establish crops followed by pastures. The main current land use activity is livestock production, and 96 percent of the area is under pasture production in La Fortuna, while 50 percent in la Esparza (30 percent is still forest land). Among the cattle production systems, beef cattle is most common, followed by double purpose cattle and dairy cattle, with 48, 28 and 20 percent, respectively. The remaining area is used for other agricultural activities such as forest production, coffee, honey and different roots products. Because of the active volcano and scenic beauty, tourism grew in La Fortuna area where dairy farming is still the main land use activity. Many cattle farmers (> 30 percent of farmers) are now interested in promoting eco-tourism by planting trees that attracts birds and other wildlife and by developing silvopastoral systems to make the landscape more attractive. Slash and burn agriculture is not practiced in the target areas anymore.

Social Organization.

More than 75 percent of dairy farmers in the La Fortuna region belong to the DOS Pinos Cooperative which provides milk collection and input services. DOS Pinos also provides technical assistance and it is a very active cooperative. More than 65 percent of the small cattle farmers in the la Esparza region are members of the "Centro Agricola Cantonal" that provides services and technical support to the farmers. This zone also has a cooperative which operates a "Subasta" for ensure minimum prices for the sale of animals.

Direct Beneficiaries

The project would benefit 180 small and medium livestock farmers in the target areas (90 farmers in la Fortuna and 90 farmers in Esparza) who depend on cattle production as a main source of livelihood. These farmers would benefit directly from the project, as the silvopastoral technology would enable them to adopt more intensive systems, diversify their farm production, reduce risk, increased land value, increase higher net income per family, and provide more stable land use.

Indirect benefits

- Six hundred fifty small and medium farmers (400 farmers in la Fortuna and 250 farmers in Esparza) would

benefit indirectly, with knowledge of the systems that are being promoted through the demonstration effects of training events, farmer to farmer contact, and establishment of improved systems which serves as demonstration plots.

- Seven hundred workers (450 in la Fortuna and 250 in Esparza) would have better knowledge of the systems by indirect participation in training events, circulation of leaflets and through farmer-worker means of communication.

- Seven hundred rural families (350 in each target zone) would benefit indirectly with a source of employment on the farms on which technologies would be established;

- Thirty families of local assistants would be contracted to participate in training events and technical assistance on different aspects related to management of livestock and silvopastoral systems.

- Fifty local workers contracted by communal or private nurseries would be required to produce tree seedlings or plants for target farmers.

- Four cooperatives in Esparza strengthened to increase its capacity for processing milk and cheese production.

- Seven institutions (INBIO, FUNDECOOPERACION, MIRENEM, CCAD, MAG, MINAE, Centro Agricola Cantonal) would benefit with information and maps generated by project for policy and decision making.

- Operators of Agricultural services would benefit through the demand for seed material and other inputs and services.

Affected:

The introduction of improved technologies would eliminate the use of chicken litter for feeding animals in the dry season, which is being sold by small poultry farmers. These farmers would be target for TA of the project.

Conclusion

In general, one observes in the project areas several processes of degradation of natural, increased erosion and the impoverishment of soils with declining production, income, and consumption levels, increasing water pollution and health problems. Population growth in general is very high.

Development policy and programs for the marginalized poor have tended to be inconsistent, misdirected, or unsatisfactory. Opening national forestlands to landless peasants and promoting extensive cattle-breeding furthered deforestation. Trade liberalization in the late nineties left most basic grain producers economically non-viable and the government's political commitment to the peasantry virtually ended.

There are potentialities as well. Principal among them (though not universally present in the three project areas) are: (a) a rapidly deepening consciousness of the problems of environmental degradation, (b) successes in sustainable productive systems, (c) specialized campasinos cultural knowledge, (d) social organizational capacity, (e) land tenure, (f) co-operatives and associated social systems and (g) the capacity of many women to strategically direct knowledge and income toward family betterment.

The three countries would benefit from project activities through the stabilization of agricultural frontier's major threat to the Mesoamerican Biological Corridor that spans from Mexico to Colombia, and the maintenance of different agro-ecosystems where natural resources are managed in a sustainable way. This project would serve as a model to disseminate the silvopastoral practices to a bigger geographic scope in each country and would

contribute to long-term continued growth. The project areas would benefit in terms of an increase in income and better ecosystem management, but also in terms of strengthened grass roots community organizations and NGOs

The results of the SA indicate the need to tailor the activities of the project to the specific conditions of the communities located in the three different areas, taking into consideration their socioeconomic and cultural differences. Specifically, in order to enhance the social impact of the project, the following activities need to be planned and implemented: (1) strengthening social organization; particularly those oriented to income-generating activities; (2) promoting a gender approach in the generation and distribution of income as well as in communal decision making and the distribution of labor; and (3) increasing their technical capacity for self-managed development in different fields.

The bulk of the above activities would be incorporated into the Capacity Building Program, which would focus on the following topics:

- Social organization for production
- Community administration skills
- Conflict resolution at the community and inter-community levels
- Sustainable use of natural resources
- Specialized technical topics, including artisan production, agriculture, ranching, apiculture, agroforestry, ecotourism, carpentry, land use planning, legal aspects related to land tenure, etc.

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Comments of the STAP reviewer

The comments of the Scientific and Technical Advisory Panel expert, Dr. Pedro Sanchez, Director-General of the International Center for Agroforestry (ICRAF), Nairobi have been addressed in detail in this annex and incorporated into the project document, as described below. The reviewer's comments are quoted below and each recommendation is followed by the Task Teams response.

Dear Cees,

I have read carefully the silvopastoral project proposal and related comments. I find the project highly innovative and one worthy of GEF funding but feel strongly that before approval following issues should be clarified:

1) The specific silvopastoral system that will be implemented in the different project areas. To me it is insufficient to talk about silvopastoral systems in generic terms. The proposal should include "best bet" silvopastoral system with a complete description of which tree species and pastor species will be used, their spatial configuration, crop-pastors-tree sequences, the main management action, etc. In addition, I would assume that each of the silvopastoral systems will have a live fence component with *Gliricidia* or other suitable species. Are they planning to plant trees into existing grazed pastors, or are they starting from scratch, ploughing, fertilizing, using an annual crop in which trees are inter-planted to be followed by pastoral species? Will they have "protein banks" under silvopastoral systems, for example, *Centrosema macrocarpum*, or other shade tolerant legumes under trees like pejibaye? Such protein banks could be grazed in rotation with conventional pastors. A clear description of this specific agroforestry system at each of the sub-site is to me an essential requirement before approval.

The Task team fully agrees with this comment. The different sites will have different requirements regarding species composition, etc. More detailed description of the system to be used are provided in Annex 2, which will be elaborated at appraisal.

2) The project needs to state specifically how does 1/10th of the area in the silvopastoral systems will provide ecosystem services for the rest.

The Task Team comments: The effect of the silvopastoral system in terms of reduced erosion at the watershed level, the provision of connectivity through biological corridors, and the reduced pressure it provides on the hill sides, clearly transcends the part of the participating ranch only planted in silvopastures. A scale up of ten is therefore assumed. This explanation is now included in the latest text.

3) The projections in carbon sequestration are based on data by CIAT in Carimagua, Colombia. I doubt very much that such data are applicable to the project locations in Nicaragua, Costa Rica and Colombia. I suggest that it is better to use carbon sequestration potential rates of agroforestry systems and improved grasslands that appear in the recent IPCC report "Land Use, Land Use Change and Forestry". Please make sure that a distinction is made whether the proposed actions represent land use intensification or land use change (the conversion of degraded croplands and grasslands into silvopastoral systems). This distinction makes a big difference in the carbon sequestration potential as indicated in this IPCC report.

Task Team fully agrees with this comment. Indeed one of the key parameters to be followed would be the amount of C accumulated. However, the estimates are now adjusted in the text, and are now in line with the other

experiences and the IPCC report.

If you consider it appropriate, I would be glad to look at the revised version again.

The task team gladly accept this invitation.

With best regards,
Pedro Sanchez

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REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

Complementarities among GEF Projects in the Colombia-Andes				
Project	**SILVOPASTORAL REGIONAL PROJECT (RSP)**	**Colombian Massif (RSP)**	**NAYA CORREDOR (MSP)**	**BIODIVERSITY IN THE ANDES (RSP)**
Location (see Map)	Nicaragua-Costa Rica-Colombia (in part of Valle del Cauca y Quindio). Local level.	Colombia: Massif Region Regional level	Colombia: Naya-Munchique-El Pinche Corridor Local Level	Colombia: Andes National Level
Principal objective	Reconversion of degraded extensive livestock systems into silvo-pastoral systems, contributing to reduce climate change (carbon sequestration), improve watersheds and promote agro-biodiversity. (Environmental Services)	Incorporate biodiversity conservation in regional planning in the Massif, by developing a framework of protected areas under various management categories and ownership, testing and replicating alternative land-use models and engendering the participation of local, regional and indigenous stakeholders in conservation	Creation of a Biological Corridor Naya-Munchique-El Pinche with the participation of indigenous communities. and African-Colombian communities	Umbrella role. To increase conservation, knowledge, and sustainable use of globally important biodiversity of the Colombian Andes by testing of various conservation strategies: regional systems of protected areas, biodiversity conservation in rural landscapes, Andean biodiversity baseline construction and monitoring, educational programs and intersectoral coordination
GEF Operational Programs	OP12 Global Benefits: Carbon Sequestration Biodiversity Water Management Land Degradation	OP3-OP4-OP12 Global Benefits: Biodiversity Conservation	OP3-OP4-OP12 Global Benefits: Biodiversity Conservation	OP3-OP4 Global Benefits: Biodiversity Conservation

Ecosystems/ Vegetations	Tropical dry forest and Pre-mountain humid forest .	Using Dinerstein and the Von Humboldt Ecosystem the Bioregion is North Andean Tropical Moist Forest and within this the ecosystems are tall, medium and low dense forest, and paramo	Pre-mountain humid forest, Mountain humid forest, Tropical humid forest.	All ecosystems in the Andes
Ecoregions of Global Importance (according to Dinerstein et al WWF/World Bank report, 1996)	Colombia. Cauca Valley dry forests: Geographical Valley of Cauca River and foothills of Central Mountain Range.	Colombia. Confluence of 5 ecoregions of montane forest: Northwestern Andean; Cauca Valley; Cordillera Oriental, Magdalena Valley; Eastern Cordillera Real and North Andean Paramo) central Mountain Range and the inception of the Eastern Cordillera. Departments of Cauca, Huila, Tolima, Valle del Cauca, Nariño, Putumayo	Colombia. 2 eco-regions: Western Mountain Range mountainous forest and Chocó-Darién moist forest. Department of Cauca	Colombia. National coverage Andean region; 5 ecoregions of mountainous forest: Andean Northeast, Cauca Valley, Magdalena Valley, Western Mountain Range, Real Mountain Range; 3 ecoregions of dry forest: Cauca Valley, Magdalena Valley and Patía Valley; and the North Andean Paramos eco-region;
Altitude Range (meters above sea level)	950 – 1.500	2.000 – 4.000	1.600 – 2.500	500 – 4.500
Southwestern Protected Areas	Private reserves: El Hatico, Pozo Verde and others.	Natural National Parks Las Hermosas, Nevado del Huila and Puracé; departmental and municipal protected areas; private reserves; indigenous reserves; and peasant conservation areas.	National Park Munchique, Private Reserve El Tambito	National Park Los Nevados, Regional Reserves and Private Reserves
Agro-ecosystems	Tropical livestock, agro-industrial coffee and sugar cane	Participatory testing and validation of alternative techniques and production systems for high altitude potato cultivation and livestock rearing; and sustainable management of montane forest	Traditional coffee, cane for artisanal brown sugar, livestock.	Shade and exposed grown coffee; Mountain livestock, Forestry, Potatoes and Andean fruit trees and products.

Local Communities	Small and medium farmers. No indigenous groups.	Paeces, Yanaconas, Guambianos, Coconucos, Totoroes, Inga and Kamtza ethnic groups, peasant farmers and new settlers, environmental NGOs.	Indigenous communities, small farmers, new settlers, African-Colombian.	Small and medium farmers, campesinos, indigenous groups, research communities (universities), environmental NGOs
Executing Agencies	Costa Rica = CATIE – Regional Scientific Center Nicaragua = Instituto Nitlapán - Private research & development institute Colombia = Foundation CIPAV – NGO	Special Administrative Unit of National System for Protective Area, South Andean Region – National State Institution	NGO consortium led by Proselva.	IAvH
Bio-geographic characteristics	The Cauca River Geographical Valley has remarkable similarities with Caribbean Coastal Plane, although it has elements of Chocó and Central Andes. The Central Mountain Foothills share important elements similar elevations of the western mountain range (both slopes) *Between Western and Central Cordillera* *Pacific/Andean bio-geographical regions*	Three bio-geographic regions converge in the Massif - the Pacific, Andean and Amazon. It marks the only continuous link between the Central and Eastern Cordilleras and thus between the Central Cordillera and the Amazon *Central Cordillera and inception of Eastern Cordillera* *Pacific/Andean/Amazon bio-geo-graphical regions*	The ecological continuous along this altitude range in the pacific slope has affinities with the rest of the biographic Chocó, and it representative of the southern part of San Juan River Basin *Western Cordillera: Pacific bio-geographical region*	Three parallel mountain chains raising up to 5000m with two main internal river valleys. It presents all climates from hot and cold deserts to dry and wet high cold mountains. Soils are mainly young in evolution but are derived from almost all kind of material. As a result it hosts a great variety of ecosystems: paramos, wet and dry mountainous forests, wetlands and xerofitic and subxerifitic environments.
Current conservation stage	Widely perturbed region. Scarce and reduced remnants of natural habitats with low connectivity and high fragmentation. Presence of local, regional and global endangered species	Variable stages of perturbation. Some of the countries most extensive remnants of montane and paramo vegetation in well conserved state are found in the Massif but with progressive stage of perturbation. Medium to high connectivity. Presence of local regional and global endangered species.	Variable perturbation but reduced in wide sectors. Large patches of natural vegetation with good connectivity and medium or reduced fragmentation. Presence of local, regional and global endangered species.	From low to very high perturbation depending on land use. Variable size relicts of original habitats. Low to high connectivity and fragmentation. Presence of local, regional and global endangered species.
Expected impact on natural	Natural regeneration and/or restoration of inter-Andean	Reduction of human pressure on protected areas. Increment in	Greater protection in special management areas. Maintenance of	Natural regeneration of mountainous

resources	ecosystems. Increment of connectivity between fragments in agricultural landscapes. Increase and diversification of vegetable cover in agro-ecosystems. Greater dispersion and genetic flux among isolated populations	connectivity between habitat remnants and six ecoregions; increased coverage of strategic ecosystems; conservation of Colombia' s main area for water production and regulation area (the source of four of the country's five major rivers)	connectivity in a biologically strategic altitudinal gradient	ecosystems and increase in connectivity among fragments in agricultural areas. Greater dispersion and genetic flux among isolated populations.

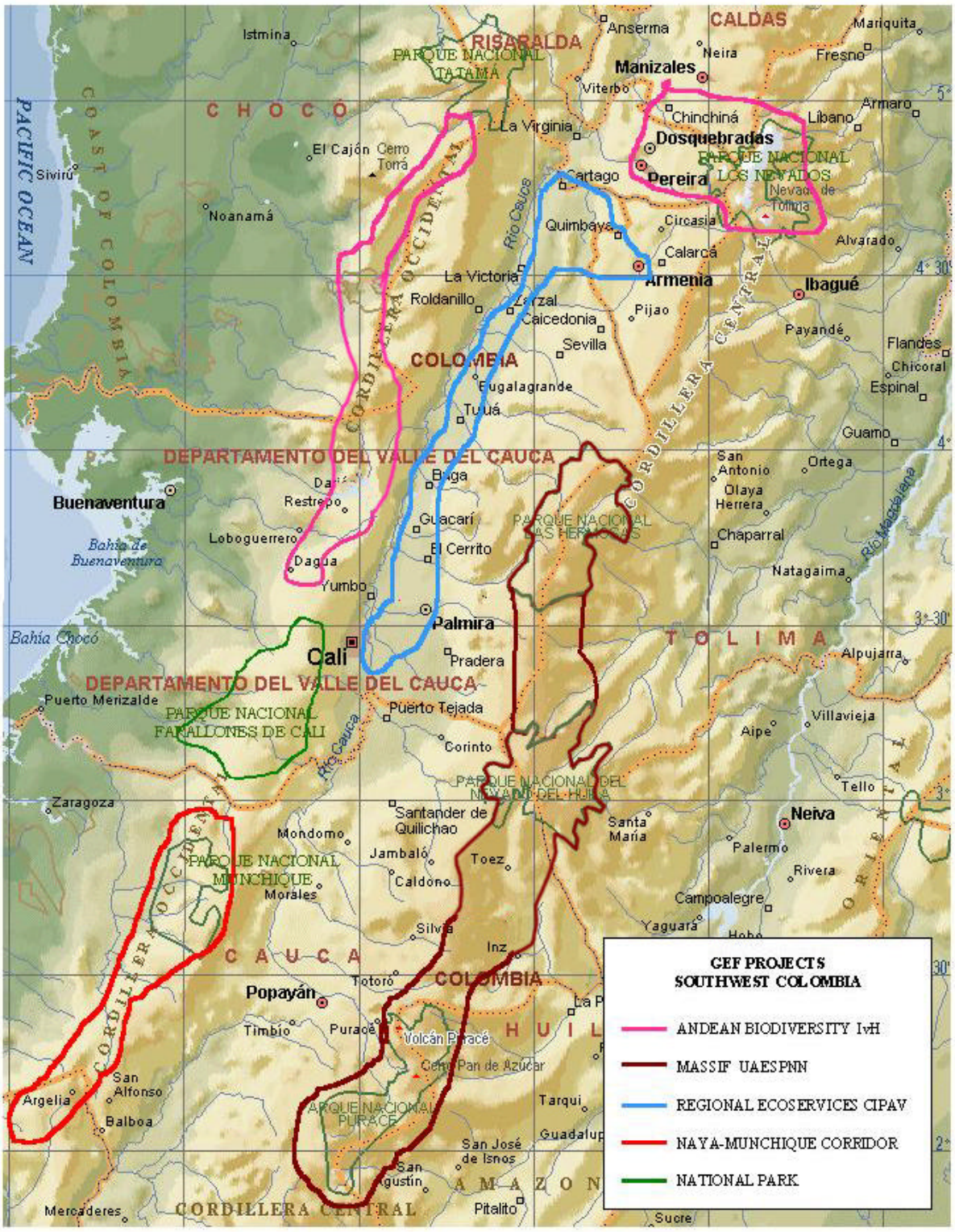

Figure 1: Map of complementarities among GEF Projects in the Colombia-Andes

REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

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Project Documents

Initial Financial Cash Flow of Model Farm of 70 hectares.

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REGIONAL (NICARAGUA, COSTA RICA, COLOMBIA)

Integrated Silvopastoral Approaches to Ecosystem Management (OP12)

MAPS

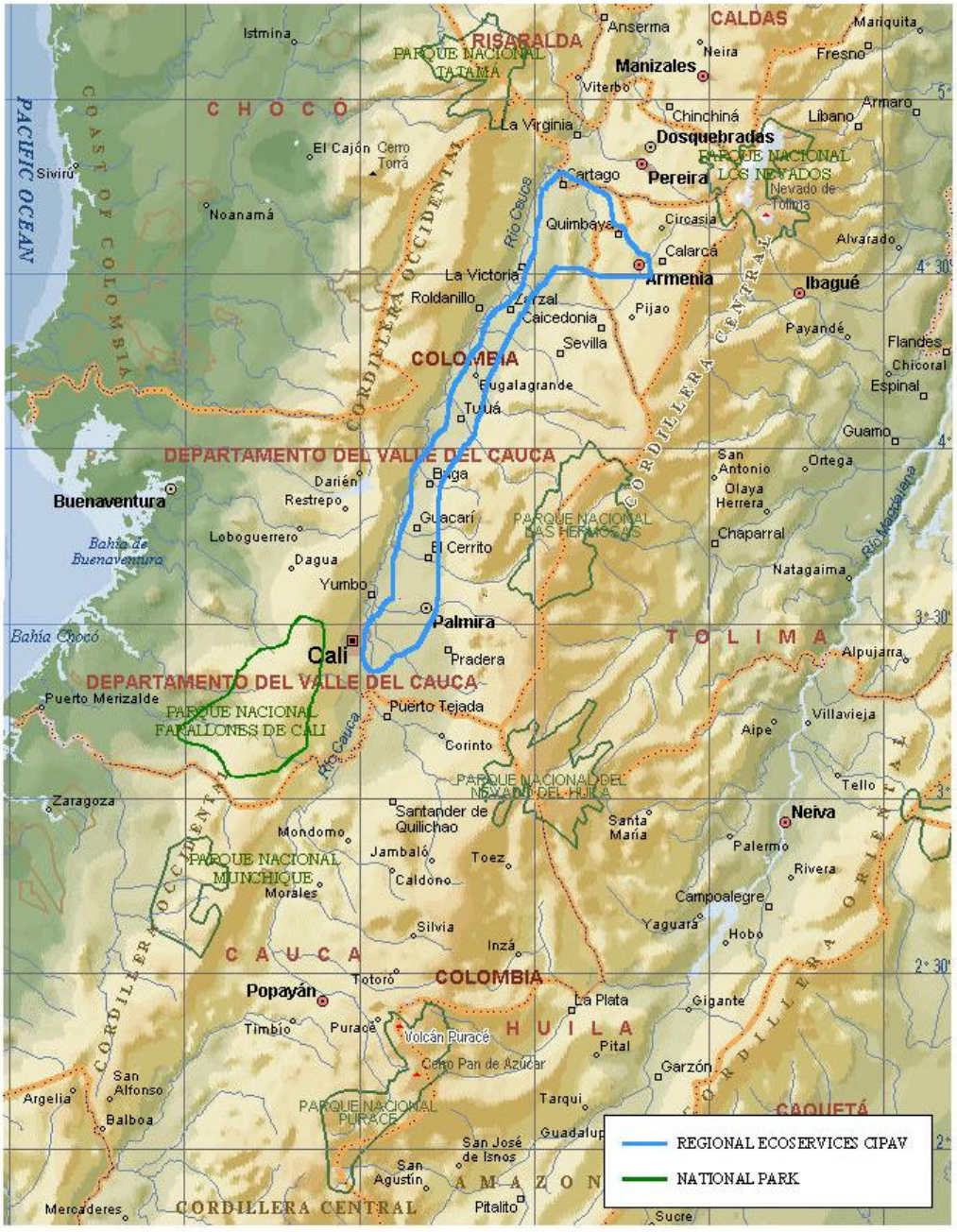

Figure 2 Site map Colombia

Figure 3: Site Map Costa Rica

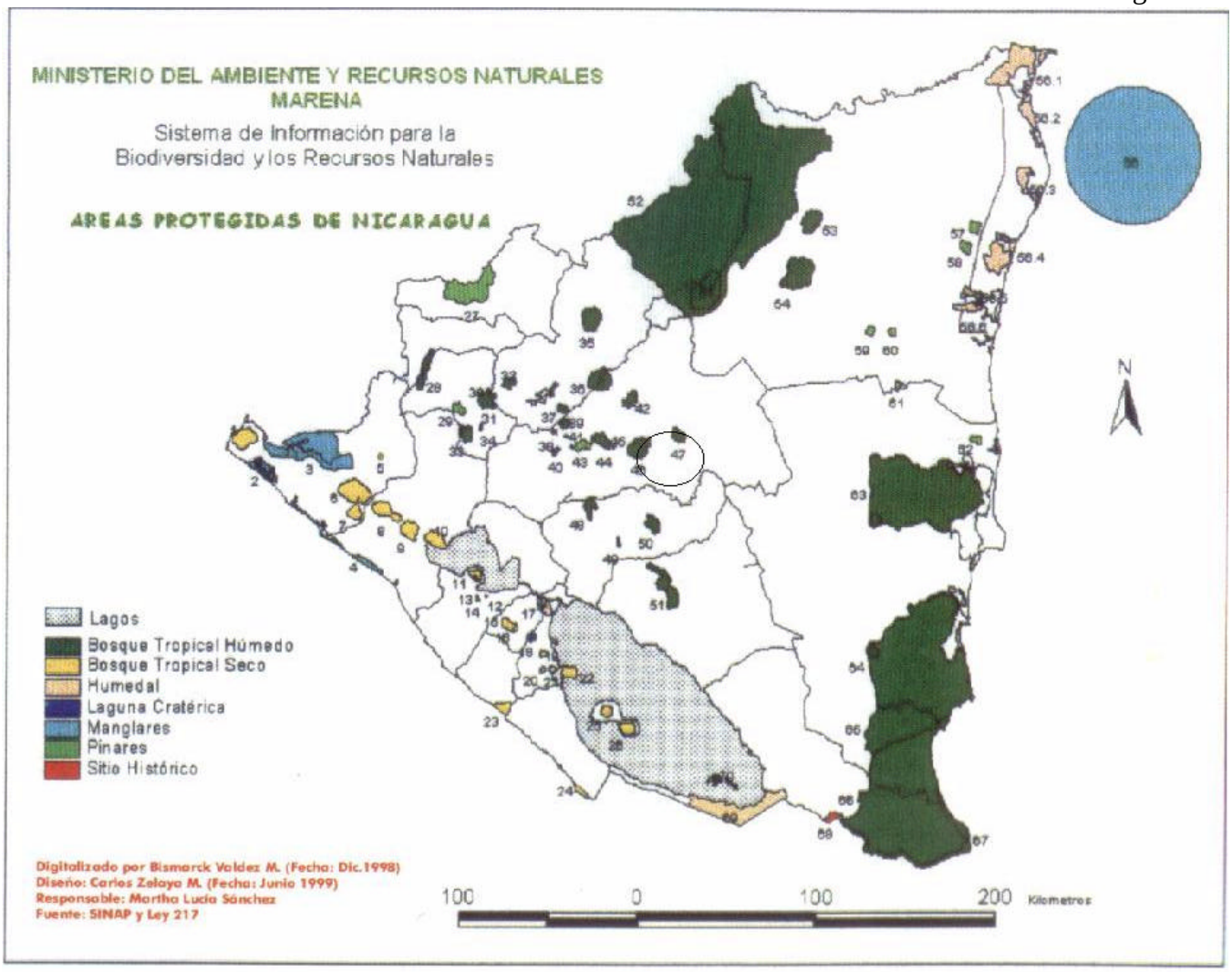

Figure 4: Site map Nicaragua