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

OFFICE MEMORANDUM

DATE: March 16, 1999

TO: Mr. Kenneth King, Assistant CEO, GEF
Attention: Program Coordination

FROM: Lars Vidaeus, GEF Executive Coordinator

EXTENSION: 3-4188

SUBJECT: **Mexico – Oaxaca Sustainable Hillside Management Project**
GEF Medium-Sized Project (MSP)

1. Please find attached the final Project Brief for the "Mexico - Oaxaca Sustainable Hillside Management Project" submitted to the World Bank by the Colegio de Postgraduados de Chapingo (CPC).

2. This project was reviewed at the March 10 Targeted Research Committee meeting and cleared for approval as a demonstration project. Based on comments provided at that time by TR committee members and by GEF Secretariat staff, the project team has revised the Brief as follows:

   - MSP activities are now limited to targeted research focused on measuring carbon sequestration in different hillside production regimes and on understanding socio-economic variables necessary for adoption of such systems;
   - the cost of activities related to biodiversity conservation in the productive landscape has been deleted and no GEF funding is requested for these activities;
   - the global objectives and benefits from the project have been clarified to provide a clearer distinction between the baseline and the GEF alternative; and
   - the discussion of sustainability and risk factors has been expanded.

3. In accordance with operational guidance for approval of Medium-Sized Projects, we are submitting two copies of the revised Project Brief for final GEF Secretariat review prior to circulation to the GEF Council.

4. We look forward to receiving your clearance to send over 75 copies for GEF Council review. Thank you and best regards.

cc: Miller (GEF); Brizzi, Hernandez (LCC1C); Redwood, Wiens (LCSES); Pieri (RDV); Kimes, Sinha, Bossard (ENVGC).

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1. PART I – ELIGIBILITY

1. Project name: *Oaxaca Sustainable hill-side management*	***2. GEF Implementing Agency:*** *The World Bank*
3. Country or countries in which the project is being implemented: México	***4. Country eligibility:*** México ratified the Framework Convention on Climate Change on March 11, 1993 and meets all other eligibility requirements.
5. GEF focal area(s), and/or cross-cutting issues: Climate change Cross-cutting area: Land degradation	***6. Operational program/Short-term measure:*** Short-term measure: Targeted Research, focused on carbon sequestration

7. Project linkage to national priorities, action plans, and programs:

- Cuicateca, Mazateca and Mixe regions, covering a total surface area of 11,629 km2, are the major indigenous zones of the State of Oaxaca. Seventy-five percent of the 370,000 total population is indigenous, from 57 "municipios", with a high density on the steep slopes of this mountainous region. Eighty-six percent of the active population, located in 66,526 farming units, is directly involved in crop and animal production (217,957 ha), and particularly in the "milpa" cropping system (64,000 ha). The "milpa" system, developed on sloping lands ("milpa de ladera") is a complex mixed cropping system based upon maize crop in association with bean, chile, calebasse, potato, "chilacayote" etc.. This system has a strategic importance for Mexican food security. Eighty percent of the total maize produced for human consumption in México (i.e. 7.2 million tons, out of a total national maize production of 18 millions) comes from milpa systems. Milpa represents a total of about 7 million ha across the country and thirty two percent of the total cultivated land area in Mexico.

- However, traditional milpa land management, based upon deforestation and burning ("roza-tumba-quema") degrades heavily the environment, particularly under current human population pressures which do not allow enough time for regeneration of native vegetation and land quality. These unsustainable practices result in heavy deforestation, particularly along steep slopes harboring globally important forest remnants with high endemism and rich in biodiversity. According to WWF, these southern Mexican dry forests are the richest tropical dry forests in the world with high level of regional and local endemism. In addition, this region of Oaxaca is one of the centers of germplasm origin and diversification for maize species. In addition to the continued loss of these globally important ecosystems, the degradation spiral results in indigenous areas of Oaxaca increasingly suffering from decrease of farmers income, rural poverty, malnutrition, human health problems, poor levels of education and high rate of migration to urban environments, creating slums settlements.

- **National priorities.** The Government of Mexico (GOM) is firmly committed to address the issue of rural poverty and environmental degradation at its roots and, with financial and technical support from the World Bank, GOM is currently developing a "Project of Sustainable Rural Development in Marginal Areas" (PSRDMA), with a special focus on improvement of land productivity through sustainable land management practices. The Project will be initially launched in four States (Oaxaca, and the Huasteca region from Veracruz, San Luis Potosi, and Hidalgo), and will be delivered through community-based leadership. Building on the results of this initial phase, the GOM expects to expand this community-led program to a total of 24 indigenous areas of the country within the next 8 years (1998-2005).

- The proposed GEF medium size project (MSP) would be implemented in conjunction with PSRDMA activities in three indigenous localities in the State of Oaxaca. The GEF MSP would support implementation of activities designed to address global environmental objectives and would complement the main PSRDMA focus of promoting sustainable agricultural practices. Specifically, the proposed GEF MSP would support targetted research to explore carbon sequestration impacts associated with proposed sustainable agricultural practices.

- The proposed GEF medium size project (MSP) would be implemented in close collaboration and

complementarity with on-going **international programs**, in particular a) the UNDP-funded program "Alternative to Slash-and-Burn" which welcomes the development by this MSP of specific below-ground carbon stocks assessment at farmers filed and micro-watershed levels (ASB Report of the 6th Annual Review Meeting, August 1997), and b) the UNEP environmental impact assessment developed for the Central American Region.

8. GEF national operational focal point and date of country endorsement: Secretaria de Hacienda y Credito Publico, Dirección de Organismos Financieros Internacionales
Submitted: November 12, 1997 Acknowledged: December 1, 1997 Endorsed: May 15, 1998

2. PART II – INFORMATION ON ACTIVITIES

9. Project rationale and objectives: The proposed targeted research program would generate field data on actual carbon sequestration associated with different production regimes based on the milpa system , and would develop an appropriate field methodology to measure carbon stock changes at field and micro-watershed levels, contributing to greater clarity on these broad scientific questions. It would also generate valuable information on the social variables involved in working effectively with indigenous and rural communities so that sustainable land-use systems, which integrate carbon sequestration objectives, are adopted in practice. It would ultimately assist GEF in developing operational guidance for projects to combat Land Degradation and to enhance carbon sequestration in rural landscapes.	**Indicators:** Measurements of a) biomass produced annually, b) carbon accumulated above and below ground, during a 5 year period, in each type of soil use and for each technological alternative. Index of the carbon pool, index of carbon lability, and index of carbon management. Improved land management systems are adopted by the indigenous communities, while soil fertility and soil productivity are increased.
10. Expected outcomes: • **a better understanding** of how to work with local indigenous communities to develop sustainable management practices with high carbon sequestration potential; • a better understanding of the practical feasibility of monitoring carbon sequestration in soils and crops at the small farmer level in relation to the milpa system; • specific data on carbon sequestration in soils and crops collected at the field level, disaggregated by different production systems; • identification of practical considerations related to carbon sequestration in the small farmer agricultural landscape that should be included in a future potential Carbon Sequestration Operational Program.	Indicators: • **Description** of the decision process adopted by farmers in relation to use of the soil and plant resources, and technological alternative proposed. • Increments of total biomass in traditional and improved "milpa"; reduction or elimination of the the fallow period. • Indicators to estimate changes of carbon pools, indexes of carbon lability, and indexes of carbon management. • Description of cropping techniques and description of training activities implemented to prepare farmers for adoption of improved land management practices.
11. Proyect activities to achieve outcomes (including cost in US$ or local currency of each activity): • Development and implementation of the methodology for measurement of carbon sequestration appropriate to hillside conditions in indigenous areas. (Total Cost $ 432,785, Baseline $ 188,950, GEF$ 243,835)	Indicators: • Measure of Carbon and nutrient pools for existing and improved soil use and soil management systems. Prediction of changes in the carbon pools by means of models. Capability of the different soil uses to act as carbon sinks.

• Strengthening services and local capacity to develop a detailed geographical stratification of the region, including but not limited to the three pilot areas, a) to assess the potential for C sequestration per major land use systems represented in the three selected microsheds and b) to assess the regional impact of carbon sequestration n areas similar to the three selected microsheds on the basis of GIS work. (Total Cost $ 647,980, Baseline $ 345,750, GEF $ 302,230).	• Development of maps of land use systems for the three regions, which include estimated potential capability to store and maintain carbon in the different improved land use systems.
• Complementary survey of indigenous communities to better understand the conditions of socioeconomic sustainability for adopting improved land management practices which are conducive to C sequestration. (Total Cost $ 200,595, Baseline $ 100,010, GEF $ 100,585)	• Achievement of socio-economic surveys in 1st and 4th year, including development of specific case studies as required.
• Additional support to adaptation of alternative technologies, the development of practical indicators which include the concepts of a) C sequestration and b) land degradation control, and their integration into routine research and extension recommendations (Total Cost $ 205,990, Baseline $ 151,635, GEF $ 54,355).	• Increase in the productivity of the land, and increase of the land-relative use-efficiency index in the selected microwatersheds. • Development of low-cost indicators of impact of improved technologies on C sequestration.
• Capacity building and dissemination. (Total Cost $ 83,880, Baseline $ 70,055, GEF $ 13,825).	• Producers and advisers technically qualified, courses, conferences, videos and publications.

12. Estimated budget (in US$)

The GEF would finance the incremental costs associated with the MSP project activities. Substantial co-financing has been mobilized to finance baseline activities to support the overall program on Sustainable Hillside management in the State of Oaxaca, Mexico.

PDF A:	$25,000
MSP:	
GEF:	$714,830
Co-financing (PSRDMA):	$443,660
Co-financing(INIFAP-CP):	$412,740
TOTAL:	***$1,571,230***
TOTALGEF (PDF A+ MSP)	***$739,830***

3. PART III. INFORMATION ON THE APPLICANT INSTITUTION

13. Name:
Colegio de Postgraduados de Montecillo (Colegio de Postgraduados de Chapingo).

14. Date of establishment, membership, and leadership:
February 22; 1959; Director: Dr. Benjamín Figueroa Sandoval

Faculty: 406, including 138 scientist,
Project Leader: Dr. Leobardo Jiménez Sánchez

15. Mandate/terms of reference:

Created in 1959 by GOM as a parastatal, CPC became in January 4, 1979, a public autonomous institution registered on 1/17/79 in Texcoco (Mexico). The institution is regulated by a Charter, recently updated (March 1998).

The mission of CPC is to contribute to rural development through postgraduate education, research and provision of services and technical assistance in the areas of agriculture, animal husbandry and forestry. Since 1960, about 3,000 students have been graduated, originated from Mexico, Central America and South America.

In addition to the academic campus (100 ha) located in Montecillo (36.5 km from downtown Mexico DF), CPC manages 5 experimental stations disseminated across the country. Up-to-date scientifc equipment and laboratories are operationnal, including services of direct relevance for this project such as Remote sensing and GIS, national data base on soil, land use, land cover, hydrology, climate etc.

In 1993, CPC was restructured into four institutes to better respond to the demand, including at global level: Institute of Genetic Reources and Productivity, Institute of Natural resources, Institute of Socio-Economics, Statistics and Information.

CPC is governed by a Board of Directors, with representative from SAGAR, SEMARNAP, INI etc. and representatives of the four institutes. The performance and quality of CPC' activities and programs are assessed by a Technical Council, chaired by the Director General.

CPC is currently managing several nationally and internationally funded research and development programs.

16. Information on proposed executing agency (if differrent from above): Same as above.

4. *PART IV – INFORMATION TO BE COMPLETED BY IMPLEMENTING AGENCY*

17. Project identification number:

18. Implementing Agency contact persons:

Christine Kimes, Global Environment Coordinator
tel: (202) 473-3689 fax: (202) 614-0087 email: ckimes @worldbank.org
Christian Pieri, Task Manager
tel: (202) 4730358 fax: (202) 614-0165 email: cpieri@worldbank.org

19. Project linkage to Implementing Agency program(s):

The WB CAS identifies i) sustainable growth including natural resource management and environmental protection, ii) social developement through community organization and participation in the development of productive sectors such agricultue and forestry and iii) modernization of the State to bring the decision-making closer to the beneficiaries as a strategic priority for assistance. The overarching objective of the CAS emphasizes the need for a broad-based improvement in welfare and reduction in the country's poverty rates.

In keeping with these priorities, the WB is currently supporting the Project "Sustainable Rural Development in Marginal Areas" whose key objective is to improve the productivity of participating farmers through a community-based approach. Within this broad objective, the program emphasizes the agriculture sub-sector and has a regional focus in six indigenous areas, including the Mixe, Cuicateca, Mazateca regions in Oaxaca, due to the urgency to address issues of poverty alleviation and sustainable natural resources management in these marginal areas . The PSRDMA includes a broad range of activities at local and regional levels, such as productive investments in agriculture production, natural resources management, artisanal activities, processing activities; community development and capacity building. The Mexican Governmentt has requested Bank support for a potential extension of the PSRDMA into 24 indigenous areas, utilizing the Bank's Adaptable Program Lending framework. PSDRMA is at the core of the Bank's Rural Focus Program under the "Compact", in support of the Southern States Initiative being pursued with the Mexican Government.

The proposed MSP is consistent with the broad CAS objectives enumerated above and would complement the PSRDMA activities in the Oaxaca Region, as it will establish a scientific basis for integrating carbon sequestration considerations into sustainable hill-side management programs. The PSRDMA is not currently financing such activities in the proposed indigenous ares, so there will be no duplication of funding between the proposed GEF MSP and the on-going PSRDMA.

OAXACA SUSTAINABLE HILLSIDE MANAGEMENT

Project Description

1. *PROJECT RATIONALE AND OBJECTIVES*

México and most Central American countries are suffering from severe environmental degradation, particularly in rural areas where poor indigenous farmers are making their living out of the traditional "milpa" land management system in fragile and steep slopes areas ("milpa de ladera") .

Traditional milpa land management, based upon deforestation and burning ("Roza-Tumba-Quema", RTQ) heavily degrades the environment, particularly under current human population pressures which do not allow enough time for regeneration of native vegetation and land quality. These unsustainable practices result in heavy deforestation, particularly along steep slopes harboring globally important forest remnants with high endemism and rich in biodiversity. In addition to the continued loss of these globally important ecosystems, the degradation spiral results in indigenous populations increasingly suffering from decrease of farmers income, rural poverty, malnutrition, human health problems, poor levels of education and high rate of migration to urban environments, creating slums settlements..

In the case of México the development of sustainable hillside management is of critical importance for both food security and environmental protection. Eighty percent of the total maize produced for human consumption in México (i.e. 7.2 million tons, out of a total national maize production of 18 millions) comes from milpa systems. Milpa represents a total of about 7 million ha across the country and thirty two percent of the total cultivated land area in Mexico. According to WWF, Southern Mexican dry forests are the richest tropical dry forests in the world with high level of regional and local endemism[1]. In addition, some of these mountainous regions are world center of origin of major food species , such as the region of Oaxaca, where germplasm for maize and bean species occur originated.

The Government of México (GOM) is firmly committed to address the issue of rural poverty and environmental degradation at its roots and, with financial and technical support from the World Bank, GOM is currently developing a "Project of Sustainable Rural Development in Marginal Areas" (PSRDMA), with a special focus on improvement of land productivity through sustainable land management practices. The Project is initially launched in four States (Oaxaca, and the Huasteca region from Veracruz, San Luis Potosi, and Hidalgo), and is delivered through

[1] The geographic and ecological isolation of Oaxaca, in general, and of the project area, in particular, has resulted in a large number of plant and animal endemic species. The *mesofilo* woodlands present in the area protect many endemic species which are considered to be in danger of extinction, such as *Alsophila salvinii, Cnemidaria apiculata, Cyathea fulva, and Trichipteris scasbriuscula* of the fern family. A large number of endemic species, endangered by the RTQ agriculture, are also found in the tropical forests located on the Pacific side of the mountains, as well as in the *Cañada Oaxaqueña* region. Environmental and ethnic variability in the area has resulted in great variation in the maize which farmers grow, as the several ethnic groups tend to plant different races of maize.

community-based leadership. Building on the results of this initial phase, the GOM expects to expand this community-led program to a total of 24 indigenous areas of the country within the next 8 years (1998-2005).

The proposed GEF medium size project (MSP) would be implemented in conjunction with PSRDMA activities in three indigenous areas in the State of Oaxaca (Cuicateca, Mazateca, and Mixe), which are promoting sustainable agricultural practices, including concern on land degradation control. The GEF MSP would support implementation of activities designed to address global environmental objectives, particularly those related to carbon sequestration. Specifically, the proposed GEF MSP would support**targeted research** to: (a) explore carbon sequestration impacts associated with improved land management practices in several production systems associated with the milpa; and (b) determine the social variables that possibly influence the process of adoption of practices to both increase soil carbon content and improve productivity of farmer resources.

The proposed GEF medium size project (MSP) would be implemented in close collaboration and complementarity with on-going **international programs**, in particular a) the UNDP-funded program "Alternative to Slash-and-Burn" which welcomes the development by this MSP of specific below-ground carbon stocks assessment at farmers field and micro-watershed levels (ASB Report of the 6th Annual Review Meeting, August 1997), and b) the UNEP environmental impact assessment developed for the overall Central American Region.

It is recognized that there are substantial global benefits arising from carbon sequestration related to the prospect of biomass extracting CO_2 from the atmosphere and thereby providing the opportunity to sequester carbon in the biomass. In addition to the potential for carbon management strategies, biomass grown on a fixed amount of land will serve multiple purposes simultaneously as are described in this document. However, the impact on the carbon cycle will depend in complex ways on the species selected and their growth rates, the prospective uses of the biomass, the time horizon of interest, and the prior use of the site. The Scientific and Technical Advisory Panel (STAP) indicates[2] that complex models are needed to understand better the carbon balances of such systems as a basis for making definitive judgments about alternative strategies. Moreover, decisions relating to future carbon sequestration project design will depend on considerations such aslocal costs and benefits, as well as carbon cycle costs and benefits. STAP has also considered measurement is one important tactical issue that would have major public policy significance and considers the process of measuring carbon accumulation in trees and soils as a result of sequestration efforts is a difficult and nontrivial exercise that warrants careful scrutiny. The targeted research component of this project for carbon sequestration will address the factors that STAP has considered relevant for more effectively implementing carbon sequestration projects.

[2] *Report of the STAP Brainstorming Session on Carbon Sequestration,* GEF/C.12/Inf.13, September 14, 1998

2. *CURRENT SITUATION AND BACKGROUND INFORMATION*

Cuicateca, Mazateca and Mixe regions, covering a total surface area of 11,629 km2, are the major indigenous zones of the State of Oaxaca. Seventy-five percent of the 370,000 total population is indigenous, from 57 "municipios", with a high density on the steep slopes of this mountainous region. Eighty-six percent of the active population, located in 66,526 farming units, is directly involved in crop and animal production (217,957 ha), and particularly in the "milpa" cropping system (64,000 ha). The "milpa" system, developed on sloping lands ("milpa de ladera") is a complex mixed cropping system based upon maize in association with bean, chile, calebasse, potato, "chilacayote" etc..

2.1 Ecological characteristics:

The Mazateca, Cuicateca and Mixe regions have similar biophysical characteristics. Three ecological strata are identified in these regions, based upon altitudinal range and native vegetation:

- High Zone. Areas that lie above 1,500 m, with very rugged topography. The zone has a temperate climate with average annual temperatures that vary from 10 to 20 degrees Centigrade. Average annual rainfall varies from 1,000 mm in the Mixe region to 3,000 mm in the Mazateca region. Primary vegetation corresponds to Pine-Oak Forest in the higher parts and to *Mesófilo* Forest below 1800m.

- Intermediate Zone. Stratum that lies between 400 and 1500m in the Mazateca and Cuicateca regions and between 500 and 1500m in the Mixe region. The topography is hilly with steep slopes and deep canyons. The predominant climate is subtropical with average annual temperatures that vary from 18 to 22 degrees Centigrade. Average annual rainfall varies from 1500mm in the Mazateca and Cuicateca regions to 3200 mm in the Mixe region. The dominant primary vegetation is *Mesófilo* Forest in the higher parts and ever green forest in the lower areas.

- Low Zone. Land that lies below 400m in the Mazateca and Cuicateca regions and below 500m in the Mixe region. The climate varies from humid tropical to subhumid tropical with average annual temperatures between 20 and 26 degrees Centigrade and average annual rainfall that varies from 1,800 mm in the Mixe region to 4,000 mm in the three regions.

The percentages of land per ecological strata in each region are as follows:

Table 1. Distribution of land area per Ecological Strata (%)

Regions/Strata	Cuicateca	Mazateca	Mixe
High zone	9	2	11
Intermediate zone	62	33	22
Low zone	29	65	67
TOTAL km^2	1,905	3,244	6,471

2.2. Ethnic and Social characteristics:

According to the 1990 census, the population of the three regions amounts to 358,336 inhabitants. Population densities are approximately:

- 23 inhabitants per square kilometer all over the Cuicateca region,
- 67 on average in the Mazateca region, and
- 454, 20 and 10 respectively in the high, intermediate and low zones, in the Mixe region.

The population in the Mazateca and Cuicateca regions includes people from the *nahua*, *mixteco* and *chinanteco* ethnic groups. Mixed ethnic groups from the states of Veracruz and Michoacan, as well as relocated *mazatecos* from the lands flooded by the large dams in the low zone of the Mazateca region, are also present in the low zone of the Mixe region. Around 73% of the population in the Mazateca and Cuicateca regions, and 80% of the Mixe population, speak their native tongue; and 20% of them are monolingual (speaking only their native language).

The economically active population is about 25.8% of the total. About 78 to 86% of the workers are employed in the primary sector; the remainder corresponds to the secondary and tertiary sectors. In the high zone, a large part of the young people migrate permanently to the cities in Oaxaca, Puebla and the Federal District. More specific information related to the three selected micro-watershed is detailed in Annexes available upon request.

2.3 Land-Use and Production Systems:

Agriculture, carried out mainly on hilly lands under rainfed conditions, is the only significant economic sector in the project area.

The land use systems in the three regions reflects this predominance of agricultural activities: crop production occupies 50-65% of the total surface area. Fallow and extensive pastures cover about 30 to 40% area of, and the total area covered by "undisturbed" native forest is less than 10%. Land tenure is primarily communal in the high zone of the Mazateca region and in the three ecological zones of Cuicateca and Mixe regions. It is predominantly *ejidal* (small scale communal system) in the low zone of the Mazateca region. However, the Mazateca and Cuicateca farmers operate as though they were small land owners, or they rent land from people who have large land holdings. In most of the area, families farm 2 to 4 hectares; however farm size reaches respectively 10 and 20 hectares in the *ejidos* established in the low Mazateca and Mixe zones.

Production Systems are highly diversified in the three regions. A comprehensive socioeconomic survey developed during the preparation Sustainable Rural Development Project in Marginal Areas of Oaxaca (SAGAR, 1996), provides a wealth of baseline information on these different production systems. However, the survey provides a simplified categorization of the dominant production systems on the basis of the three ecological strata defined in terms of altitude:

- High and Very High Zones: Milpa-Migration (to urban areas) or Milpa-Migration, plus daily-waged labor (in local farms).
- Intermediate Zone: Coffee-Milpa and Coffee (plantation).
- Low Zone: Coffee-Milpa or Coffee-Maize-Poultry, Maize-Livestock or Maize-Pasture, Livestock Ranches, Plantations of Citrus Fruits.

More detailed information related to the specific farming and cropping systems encountered in the three selected areas – San Jeronimo Tecoatl/Mazateca, Asunción Cacalotepec/Mixe, and Concepción Pápalo/Cuicateca - is available upon request. A brief overview of these systems can be summarized as follows.

Maize is the principal crop in the high zones. It is associated with beans and pumpkin or *chilacayote*; in the Mixe region it is also associated with potatoes. Maize is consumed mainly on the farm and the production is usually insufficient to last all year. As their food supply dwindles, farmers consume more wild plant species that are collected from inside and outside their cultivated fields. These plants are used to complement the basic diet of maize-beans-pumpkin and small amounts are sold locally. Women commonly keep several species of poultry in the patio and use them to feed their families and as a source of revenue. Other activities include raising animals around the house, harvesting fruits and other plants from the patio for home consumption, cutting firewood and construction materials from woodland areas, production of arts and crafts, and working as a day laborers in nearby cities. Hogs and several species of poultry are grown in the patios of the farm homes. Bee culture is common in the Mazateca region. 2.6. Current production levels (see the baseline study) are as follows: on average are 560 kg/ha of maize yields in the Cuicateca region, 540 kg/ha in Mazateca and 400 kg/ha in Mixe. These yields are well below the national average which is around 2.5 ton/ha.

In the intermediate zone, farmers grow maize for their own consumption and coffee for the market. Often coffee is interplanted with perennial cash crops like banana, papaya and citrus fruits. Native coffee varieties are used and most of the trees are old. The decisions farmers make in managing their natural resources depend, in the case of the milpa, on their cultural heritage, and, in the case of coffee, on their technical knowledge plus local social organizational patterns. The price of coffee influences the way farmers make these decisions. However, average yields of unprocessed coffee are about 1600 kg/ha in the Mazateca and the Mixe regions. Yields of both crops, maize (about 500 kg/ha) and coffee can and should be increased. Farmers also grow sugarcane and produce brown sugar in the Mixe region and *aguardiente* in the Mazateca and Cuicateca regions. Producers use their knowledge of how climate varies with altitude to decide where to plant different species of chile, as well as different varieties of maize, beans and winter crops. The fragility of this livelihood is obvious, as family income depends greatly on the price of coffee.

In the high and intermediate zones, farmers use several variants of the milpa system for maize production: cut-slash-burn (RTQ), cut-slash (RT) with *machete*, cut-burn (RQ) with short fallow and cut-weed (RL) with short term fallow. Generally, field preparation is manual, although animals are used for land preparation in some parts of the high zone. Income is supplemented by cutting firewood from village woodlots, and part time employment in nearby cities where jobs are available and the laborer is not required on the farm.

In the low zone, e*jidos,* large commercial farms, and cattle ranches coexist. Most farmers practice extensive animal production, but with very poor quality pastures. Livestock receive no feed supplement and little attention to sanitation. Near the large dams in the Mazateca low zone, farmers devote part of their time to fishing; collective alternatives for the production of fish are being tried. Coffee constitutes an important source of family income in the Mazateca region. Persian lemon, orange and rubber plantings are found in the Mixe region. Although the potential for fruit tress may be high, the total production is limited, the quality is poor and the market prices are very low.

2.4 Local Organizations:

The three regions are characterized by a dense fabric of traditional, economic and political organizations. Indigenous profiles have been recently developed, illustrating the richness and intricacy of traditional institutions. In addition, during the preparation of the PSRDMA, detailed baseline information on these organizations, as well as on NGO's acting in Cuicateca, Mazateca, and Mixe areas have been compiled, such as:

- *Coalición de organizaciones Indígenas de la Sierra Mazateca Alta (COIAM),*
- *La Coordinadora Estatal de productores de Café de Oaxaca (CEPCO),*
- *Unión de Comunidades Indígenas de la Región del Istmo (USIRI)* , which is dedicated to the production and commerce of organic coffee,
- *Coordinadora de Organizaciones Democráticas Urbanas y Campesinas (CODUC),*
- *Centro de Apoyo al Movimiento Popular Oaxaqueño, A. C (CAMPO, A. C.)*
- *Unión de Ejidos y Comunidades Cuicatecos (UECC),*
- *Servicios del Pueblo Mixe A.C (SER, A.C.)* and the *Asamblea de Productores Mixes (ASAPROM. SER, A. C.), and Unión de comunidades Indígenas de la Zona Norte del Istmo (UCIZONI)* in the low zone of Mixe region,
- *Fondos Regionales de Solidaridad social (FRS),* including the *Organizaciones Zapotecas, Chinantecas (OMIZACHI),*etc.

Women's Groups are limited in the three regions, acting mostly under the umbrella of municipalities and without legal status nor linkages with the main farmers organizations. However, two women associations with legal status are active: the *Unión Autónoma de Mujeres Indigenas* UAIMs in the low zone of Mixe and Mazateca regions, and the *Sociedades de Solidaridad Social* in low and high Mazateca regions. These two associations have developed external relationships, with NGO's and other partners.

3. *OBJECTIVES AND EXPECTED PROJECT OUTCOMES*

The Medium size project, combining baseline PSRDMA activities and incremental activities generating global benefits, will develop and extend to farmers sustainable and profitable land management technologies adapted to the hillside environment, which will encompass the objectives of increased carbon sequestration. GEF Targeted research objectives include the generation of : (a) field data on actual carbon sequestration associated with different production regimes associated with the milpa system, contributing to greater clarity on these broader

scientific questions; (b) valuable information on the social variables involved in working effectively with indigenous and rural communities so that sustainable land-use systems, which integrate carbon sequestration objectives, are adopted in practice; and (c) operational guidance to assist the GEF in developing a portfolio to combat Land Degradation and to enhance Carbon sequestration in rural environments.

Specific outcomes would be as follows:

- better understanding about how to work with indigenous communities in the development of sustainable practices with a high potential for capturing carbon, and how to apply such practices in the management of natural resources;
- development of a practical way to monitor the sequestration of carbon, both in the soil and on the soil surface, in farmers' agricultural systems; identification of cost-effective indicators;
- development of methodology for measuring carbon sequestration in different production systems at field and microwatershed levels;
- identification of practical considerations related to carbon sequestration in small farm agriculture that are relevant to the implementation of future Projects, GEF and/or Governmental funded, focused on land degradation control.

4. ACTIVITIES AND FINANCIAL INPUTS

The project will be implemented over a five year period. In order to achieve project objectives and outcomes, the following activities will be implemented:

4.1 Development and implementation of the methodology for measurement of carbon sequestration. US$432,785. Following a scientific workshop organized in Montecillo, Mexico D.F. (Block A) and attended by about eighty national and international experts, a detailed methodology has been developed by the the *Colegio Postgraduados* (CP), drawing upon a) the methodology developed by the UNDP-funded project "Alternative to Slash Bum" to measure stock of carbon in the vegetative stratae, above ground and in the root systems, and b) the recommendations from the experts on Soil Organic Carbon measurements, such as Winrock International Institute for Agricultural Development ("A guide to Monitoring Carbon Storage in Forestry and Agroforestry Projects", 1997). This methodology has been ultimately reviewed and endorsed by leading expert from the Global Change Group, Northwest National Laboratory, Batelle, USA. In each microwatershed, a set of plots randomly located in the major landscape units - plus micro-plots for C measurements above and below ground surface - will be established. The amount of carbon stocks or reserves will be determined for the identified major land-use systems in each microwatershed including forest, coffee production, native pastures, cut-slash-burn *milpa*, permanent *milpa,* and two *milpa* systems managed under alternative sustainable land management practices. Precise sampling methods of plant and soils have been defined and will be executed on an annual basis. The capacity of these different land use systems to become carbon sinks will be estimated during the duration of the project. Predictive models will be used to calculate the changes that will occur over a long time period (20 years), to develop indicators of C sequestration capacity per studied land-use systems, and to rate C sequestration potential under sustainable hillside management compared to traditional

management. The *baseline costs* involve the assessment of the change in soil fertility status, and are estimated at $188,950. The *GEF incremental cost* is the cost of development of additional measurement and improved methodology for evaluating C stock and flux in the watersheds, including training of local specialists, estimated at $243 835.

4.2 Geographic stratification of the three regions for assessment of C sequestration and biodiversity conservation in hillside agriculture : $ 657,980. The World Bank financed project, PSRDMA, Federal and State research activities (INIFAP, CP), provide baseline information on climate, soils, terrains, and main native vegetation stratae of the State of Oaxaca and other Southern States, such as Chiapas etc. The *baseline costs* for collecting and analysing this data are estimated at $ 345,750. However, the evaluation of C sequestration potential at local and regional levels, as a consequence of the adoption of new hillside management practices, requires more detailed information of the actual and changing land –cover and land-use systems over the period of implementation of the project and beyond. In addition, potential change in the annual rate of soil erosion and run-off should be assessed in order to evaluate consequences on the C balance and on the preservation of habitats within the categorized major land-use systems, such as forest, long term fallow, perennial and annual cropping areas etc. The GEF MSP will therefore support: a) the establishment of land-use systems maps to assess change during the five year period, using GIS techniques already in use in *Colegio Postgraduados* (CP), and b) measurement on an annual basis of C movement in the landscapes as a result of soil erosion and water run-off; this information is required to calibrate the model SWRRB (Simulator for Water Resources in Rural Basins) which will be applied in the conditions of the three selected watersheds. The *GEF incremental cost* for these activities is estimated at $ 302,230.

4.3. Survey of indigenous communities to identify the conditions of socioeconomic sustainability conducive to the adoption of improved hillside management: $200,595. A Baseline socioeconomic survey of the three regions is being developed by extensionists and researchers from CP and INIFAP as part of the Monitoring and Evaluation component of the Project of Sustainable Rural Development in Marginal Areas (PSRDMA). Profiles of the Cuicateca, Mazateca and Mixe indigenous peoples provide also a very rich information on the social and institutional characteristics of these communities. In addition, a specific in depth socioeconomic diagnosis (with support from the Block A) was carried out in the three municipalities located in the selected watersheds. **The results are available upon request. The cost of *baseline socioeconomic diagnosis* over the five year period is estimated at $100,010.** The GEF incremental cost is the cost of two detailed surveys, including interviews of selected men and women farmers, to be executed the first and fourth year of the project. In-depth interviews will be focused on a) understanding farmers' decision-process regarding management of natural resources and subsequent consequences for preservation of plant biological diversity, and b) assessment of the rate of adoption of improved land management practices. The information obtained from these surveys will contribute to recommendations regarding socioeconomic and institutional incentives likely to facilitate the adoption by indigenous communities of hillside management practices compatible with the goals of C sequestration and sustainable use of natural resources. *The GEF incremental cost* is estimated at $100,585.

4.4. Local adaptation of alternative hillside management practices to incorporate C sequestration objectives. $ 205,990. The adoption of new land management practices by indigenous

communities raises the issue of local adaptation of known technologies to specific biophysical and social conditions. The Project of Sustainable Rural Development in Marginal Areas (PSRDMA) is supporting activities to locally adapt technologies which will increase farm income. A comprehensive program is currently developed, based upon the felt short term needs of farming communities. This includes crop and soil improvement techniques, agroforestry and fruit trees development, and home gardening development. The cost of these *baseline activities* in the three regions is estimated at $151,635. The GEF incremental cost is the cost of local adaptation of these alternatives technologies to add to the technical and profitability focus given by the PSRDMA, the concern of both environmental efficiency, in terms of C sequestration and sustainable use of natural resources, and social sustainability in the context of the selected Cuicateca, Mazateca and Mixe indigenous communities. The *GEF incremental cost* is estimated at $54,355.

4.5. Capacity building and Dissemination: $ 83,880. The Project of Sustainable Rural Development in Marginal Areas (PSRDMA), research (INIFAP, CP) and public (SINDER) and private extension groups, such as SER, CEPCO, OMIZACHI etc. provide general training on sustainable farming practices for men and women farmers from the State of Oaxaca. INCA Rural and INI also disseminate this information through different media, including a very active rural radio network. Specific information will be disseminated on existing plant biodiversity, traditional use and the sites and practices which favor their *in-situ* conservation. The cost of these *baseline activities* for the three regions is estimated at $ 70,055. The GEF incremental cost is the cost of incorporating carbon sequestration concerns in the on-going programs of education for farmers and local extensionists (living in the communities), acquisition of mobile audio-visual equipment (three sets), and organization of field days and study tour for farmers from Oaxaca State and neighboring mountainous States with replication potential for the application of the lessons learned in the three selected watersheds. The *GEF incremental cost* is estimated at $13,825.

5. SUSTAINABILITY ANALYSIS AND RISK ASSESSMENT

Factors for success:

This project is the recipient of very strong institutional support, and has been developed following a fully participatory approach.

Since the onset of the project, all the stakeholders have been involved in the design and preparation of the main components. During the preparation phase, the project has benefited from the participation, on a cost sharing base, of professors and senior research scientists in soil fertility, soil physics, and rural development from the CP and INIFAP. Since June 1998, an Oversight Committee with representatives from all the major stakeholders has been working efficiently to define and support appropriate institutional responsibilities and contributions.

This project has been designed to operate within the framework of the Project of Sustainable Rural Development in Marginal Areas (PSRDMA), which is a strategic program, fully supported by the Mexican Government and State authorities. The PSRDMA is a multi-year, phased project (APL), which is being implemented in pilot areas, with the prospect of extension to most of the

indigenous Mexican zones; eleven new indigenous areas will be added in the coming year. As a consequence, the GEF project is well known by local, State and Federal authorities, and they have provided significant support since preparation began. In particular, a three day Study tour, fully supported by SEDAF (State Agricultural Secretariat), gave the opportunity to twenty farmers and local extensionists to visit farms practicing successfully sustainable agroforestry and mixed-cropping systems in the State of Vera Cruz. The GEF project is also highly visible, and its objectives and activities are periodically reported by the State press.

Other factors which are expected to ensure the long term adoption by indigenous communities of sustainable hillside management practices, which integrate carbon sequestration objectives, include:

- heads of families, women farmers and young adults will participate in the planning, operation and evaluation of the project;
- indigenous organizations will be strengthened to enable it to resolve problems and attend the needs of the farm family at the community and regional level;
- farmers will be trained to assist other farmers in the use of improved technology generated by applied research at the small watershed and regional level, and
- farmers will be trained to assess impacts of improved hillside management practices ;
- reduction in soil erosion and improvement in soil fertility will be quantitatively assessed;
  reduction in the intensity and magnitude of run-off will be measured;
- increase in crop yields, and farm income will be quantified.

In conclusion, the participation of all the stakeholders in the preparation of this project, as well as the enthusiastic support received from rural communities up to national authorities, are expected to be decisive factors of success.

Risk factors:

Project risks involve primarily the ability of the executing agency to install and run the overall monitoring system of carbon sequestration, including run-off plots and experimental fields, and to assess changes over time of carbon storage in the three selected micro watersheds. An additional risk is the ability to develop a scientifically-sound methodology which is both appropriate to the local conditions and cost-effective.

Risk mitigation measures developed by the executing agency include: a) careful selection of low-cost and resilient equipment, already tested at farm level in Puebla, and b) intensive training of scientists, extension agents, and farmers to ensure reliability and continuity in monitoring of carbon sequestration in soil and plants. In addition, visits by technical specialists, as well as supervision missions from the World Bank, will be executed periodically, with higher periodicity at the beginning of the GEF MSP.

Project success will also depend on the efficient functioning of the Project of Sustainable Rural Development in Marginal Areas (PSRDMA) which is providing baseline financing for sustainable agriculture activities. This risk is not considered significant, as the project has been

under implementation since April 1998, and systems for project administration are functioning effectively.

Timely availability of funds will be critical, particularly for the first planting season, to : a) acquire and install field equipment, b) ensure that alternative technologies for sustainable hillside management will be in place at the onset of the rainy season (April/May), and c) deliver appropriate technical assistance and training for collection of baseline data for the targeted research activities. Approval of the GEF MSP by mid-April 1999 is consistent with the project implementation timetable determined by the agricultural cycle.

6. STAKEHOLDERS INVOLVMENT AND SOCIAL ASSESSMENT

Stakeholder involvement:

The high level of stakeholder involvement at regional, State and federal levels has been stressed already, as reflected in the composition of the Oversight Committee. Responsibilities, procedures and rules of this Oversight Committee are written and available (in Spanish). Three meetings of the Committee have taken place so far, and minutes are also available. The end result is that Federal, State and Municipal authorities, as well as indigenous community representatives, academic institutions and non-government organizations in Oaxaca, have been kept informed as the project has taken shape, contributing fruitfully to the final proposal. In this effort to inform people and get their agreement, the participation of the Project of Sustainable Rural Development in Marginal Areas (PSRDMA) has been constant, particularly with the coordinators and technicians in charge of the Regional Technical Units (UTR), belonging to the Regional Sustainable Development Committee ("*Consejos Regionales de Desarrollo Rural Sustentable*") in Oaxaca.

At the pilot watershed level, special attention was given to keeping all parties informed and to reach a common agreement between their own expectations (food security, and poverty alleviation) and GEF global environment objectives. Similarly, at the municipal level, an effort has been made to achieve full agreement among members and constituencies on the activities to be developed, with special attention to the effective participation of the Communal Land Ownership Commissariat ("*Comisariado de Bienes Comunales*"); the Commissariat is the only mechanism through which the cooperation of farmers from the same watershed can be reached, irrespective of the status of land tenure and land-use systems in the pilot watersheds.

Social Assessment and Gender Issues:

Evidence obtained during project preparation indicates that sustainable hillside management may result in greater labor demand, particularly at the initial time during which the new cropping system will be developed, and later on, in relation to land productivity increases. Increased rural employment opportunities are welcomed by the communities. Similarly the potential consequence of sustainable hillside management on a) improved water quality – decrease of soil erosion and over use of chemicals – and on b) maintenance of "useful" plant biodiversity, for nutritional, medicinal and artisanal purposes, is particularly welcomed by womens' groups who traditionally are the stewards and users of these natural resources.

By encouraging more efficient use of agrochemicals, introduction of fruit trees and permanent legume cover crops, it is expected that the project will have an additional positive social impact, which will benefit particularly women farmers dedicating often part of their time to bees and honey production in these mountainous areas.

7. FINANCING PLAN AND INCREMENTAL COSTS ASSESSMENT

Total costs of implementing the GEF Alternative/Medium Size Project are estimated at $1.57 million. IBRD, the Project of Sustainable Rural Development in Marginal Areas (PSRDMA), INIFAP and *Colegio Postgraduados* (CP), SAGAR and SEDAF will contribute $0.86 million, representing baseline investments and program management costs.

GEF support would cover the incremental costs of the proposed project, which are estimated at about $0.71 million. The targeted research program would develop the methodology and generate field data on actual carbon sequestration associated with different production regimes developed for sustainable hillside management. It would also generate valuable information on the social variables involved in working effectively with indigenous and rural communities so that sustainable land-use systems, which integrate carbon sequestration objectives, are adopted in practice.

The lessons learned from the medium size project activities in Oaxaca, Mexico, will contribute to the better understanding of the broader scientific issue of potential C sequestration in soils and the potential to integrate in sustainable rural development program global environmental objectives related to climate.

The breakdown of project costs by activity and sources of financing is shown in Table 2.

Table 2. Financial Plan and Incremental Costs ($US)

	BASELINE SCENARIO			GEF ALTER-NATIVE	INCREMENTAL COST
	PSDRDMA	OTHER DONORS	TOTAL	TOTAL	GEF
1. Methodology for measure-	70,080	118,870	188,950	432,785	243,835
Ment of carbon sequestration					
a. Carbon stocks at field level	70,080	58,870	128,950	248,785	119,835
b. Carbon stock at watershed level		60,000	60,000	184,000	124,000
2. Geographical stratification	131,465	214,285	345,750	647,980	302,230
Regional hillside zones					
a. C balance assessment per major land use systems,		189,750	189,750	443,980	254,230
b. GIS and regional zoning for potential C sequestration assessment	131,465	24,535	156,000	204,000	48,000
3. Socioeconomic survey	34,275	65,735	100,010	200,595	100,585
of indigenous communities					
a. Regional survey	34,275	43,735	78,010	155,395	77,385
b: Farmers interviews		22,000	22,000	45,200	23,200
4. Local adaptation of hillside management practices	137,940	13,695	151,635	205,990	54,355
5. Capacity building	69,900	155	70,055	83,880	13,825
And dissemination					
a. Farmers and extension agents	29,900	155	30,055	35,880	5,825
b. Field days, study tours	40,000		40,000	48,000	8,000
TOTAL	443,660	412,740	856,400	1,571,230	714,830

Budget

A PDF Block A Grant of $25,000 was approved to prepare this MSP request. Block A funds were used to organize an "expert workshop" to develop the research design and to conduct a local communities survey in the three pilot indigenous areas. Total GEF support for this project would total $739,830 (PDF + project grant).

A breakdown of MSP project expenditures, by major expenditure categories and by financiers, is presented below in Table 3.

Table 3. Project Budget by Expenditure Category

COMPONENT	GEF	PSRDMA	OTHER DONORS	TOTAL
Goods	550,330	149,270	10,000	709,600
Project management and coordination.	132,500	294,390	36,000	462,890
Technical assistance	32,000	10,000	356,740	398,740
Total	**714,830**	**453,660**	**402,740**	**1,571,230**

Project Implementation

The GEF Project will function in coordination with the activities carried out by the Project of Sustainable Rural Development in Marginal Areas (PSRDMA). The coordinator of the project, located in Oaxaca, will coordinate the activities planned to reach the objectives in each of the small watersheds selected in the three project regions.

Scientists from *Colegio Postgraduados* (CP), will implement locally the action plan developed for C sequestration at field and watershed levels. This activity will be developed in collaboration with world authoritative organizations, such as Pacific Northwest National Laboratory operated by Battelle for the U.S. department of Energy, and with members of the "Alternative to Slash and Burn" initiative sponsored by UNDP. Soil and plant analysis will be done in Oaxaca ("*Institute de tecnologia Agrícola*") for routine chemical and physical determinations, such as texture, pH, humidity, bulk density etc. More complex determinations, principally related to C balance and soil fertility status, will be carried out in the specialized labs of CP in Mexico, Montecillo.

The geographic stratification of the region, with respect to potential of C sequestration and Biodiversity conservation appropriate to land-use systems in a hillside environment, will be carried out by CP and INIFAP, with collaboration of the GIS lab of UAM, and NGOs such as SERBO-Mesofilo.

Survey of indigenous communities will be undertaken by scientists of CP and extensionists from SINDER and SEDAF attached to the Project of Sustainable Rural Development in Marginal Areas (PSRDMA) and in close collaboration with the Regional Sustainable Development Committee ("*Consejos Regionales de Desarrollo Rural Sustentable*") of the Mazateca, Cuicateca and Mixe regions.

INIFAP will play a leading role in the development of locally adapted farming and land management practices to meet the objective of Sustainable Hillside Management. Collaboration and support will be provided by INIFAP/Puebla, CIMMYT and Rockefeller Foundation with respect to agroforestry, no-till and cover-crop systems adapted to small scale farms.

Capacity building and dissemination activities will be developed in close coordination with the technicians and institutions that operate the Project of Sustainable Rural Development in Marginal Areas (PSRDMA). INCA RURAL and INI will play a central role in this domain, to strengthen farmer organizations at the municipal and regional levels, to disseminate information in indigenous languages, and to produce and show in the villages documents and videos related to some specific subject matters, such as new farming practices adapted to C sequestration, sustainable use of plant biodiversity etc. .

The scheduling of project activities over the next five years is shown in Table 4 below.

Table 4. Calendar of activities for 1999-2003

	YEAR					
ACTIVITY	1998	1999	2000	2001	2002	2003
Preparation Activities	X					
1. Methodology of measurement						
of carbon sequestration						
a. Carbon stocks at field level		X		X		X
b. Carbon stock at watershed		X		X		X
regional level						
2. Geographical stratification						
hillside zones						
a. C balance assessment		X	X	X	X	X
b. GIS and zoning for C sequestration		X	X	X	X	X
3. Socioeconomic survey						
of indigenous communities						
a. Regional survey		X			X	
b: Farms interviews				X		X
4. Local adaptation		X	X	X	X	X
hillside management						
5. Capacity building						
and dissemination						
a. Farmers and extension agents		X	X	X		
b. Field days, study tours		X	X	X	X	X

Monitoring and Evaluation

Project monitoring and evaluation activities will be supervised by World Bank supervision missions. Internal monitoring and evaluation will be carried out twice a year by the Oversight

Committee, and a report will be established annually. The annual reports will evaluate performance against agreed performance milestones, which are consistent with the overall project indicators presented in the Executive Summary Sheets. The World Bank, as well as the authorities of SAGAR and the SEDAF in Oaxaca, will be informed of the results of this internal M&E. In addition, the Project will be subject to systematic evaluation and follow-up by the members of the project team (CP) responsible for these activities.

An implementation completion report will be prepared to take stock of project performance and extract lessons. The implementation completion report will evaluate performance against the global objective, outcome, and activity indicators listed in the Executive Summary Sheets.