REQUEST FOR PROJECT/PROGRAMME FUNDING FROM ADAPTATION FUND

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to

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DAPTATION FUND

DATE OF RECEIPT:
ADAPTATION FUND PROJECT ID:
(For Adaptation Fund Board Secretariat Use Only)

PROGRAMME PROPOSAL

PART I: PROGRAMME INFORMATION

PROGRAMME CATEGORY: **REGULAR**

COUNTRY/IES:	**NICARAGUA**
TITLE OF PROGRAMME:	***Reduction of Risks and Vulnerability Based on Flooding and Droughts in the Estero Real River Watershed*** (PIMS ID 4448, Atlas IDs – Proposal 59776, Project 74925)
TYPE OF IMPLEMENTING ENTITY:	**MULTILATERAL IMPLEMENTING ENTITY**
IMPLEMENTING ENTITY:	**UNITED NATIONS DEVELOPMENT PROGRAM**
EXECUTING ENTITY/IES:	**MINISTRY OF THE ENVIRONMENT AND NATURAL RESOURCES (MARENA)**
AMOUNT OF FINANCING REQUESTED:	**5,500,950** (IN U.S Dollars Equivalent)

PROGRAMME BACKGROUND AND CONTEXT:

A. Climate Background

Nicaragua faces severe impacts related to extreme natural phenomena. Combined with already significant climate variability, socio-economic impacts are magnified by high levels of poverty. Climate variability, especially during El Niño-Southern Oscillation (ENSO) episodes, results in droughts that cause significant losses, particularly affecting the agricultural sector which provides employment for over 60% of the population and on which food security[1] depends. During the wet season, devastating floods destroy harvests, infrastructure and housing.[2] In a predominantly sub-humid tropical climate characterized by strong inter-annual variability, climate change trends pose a growing threat to continued development and to the wellbeing of poor rural communities in many areas. Current variability will be aggravated by climatic trends.

Both the First National Communication and the Second (FNC and SNC, respectively) relied heavily on extrapolations from global models and regional studies to define likely climate trends in the country. The FNC concluded that the average annual temperature could increase between 1.6º and 2.1º by 2050, with more severe changes of between 2.3º - 3.7º by 2100. This was later reconfirmed in the SNC, which notes that between 2020 and 2029 average temperatures could increase by 0.5º to 1.0º under scenarios A2 and B1. A recent study[3] of climatic extremes in Latin America concluded that temperature ranges and the variability

[1] Episodes of severe drought which have had important impacts at the national level occurred at least in 1972, 1977, 1991, 1997 and 2003.
[2] Significant floods occurred in 1988 (Hurricane Joana; Bluefields), 1991 (El Rama), 1993 (tropical storms Pert and Bret), 1995 (torrential rains), and 2008 (Tropical Storm Alma). Catastrophic landslides and torrential flows (lahares) have also been recorded, such as in Posoltega (Casita Volcano) during Hurricane Mitch (1998), which struck Central America, leaving a wake of destruction.
[3] Aguilar, E., et al., 2005: Changes in precipitation and temperatures in Central America and Northern South America, 1961-2003

among them are changing in the region. With regards to precipitation, there is significant uncertainty. According to the SNC, there are notable discrepancies between models over both temporal and spatial scales. Some models register a slight decrease in rainfall under scenarios A2 and B2 in the near term, with deeper reductions in total annual rainfall of -8.20% (B2) and -11.49% (A2), toward the latter half of the century. Other models predict different scenarios. There are also constraints in that the calibration of climate change projection models used at present may not accurately reflect current and emerging conditions in the so-called dry zones of Nicaragua, regions that are already experiencing high levels of water stress. The SNC notes that during El Niño events that have triggered severe droughts, annual precipitation in the departments of Chinandega and León has decreased on average between 19% (270mm) and 35% (516mm). During La Niña events, river levels can rise significantly; especially in October when mean flows can surpass historical averages by over 500%.

The Pacific region, where over 65% of the population lives, is the most vulnerable, with strong demographic trends, high levels of extreme rural poverty and low precipitation rates. The areas that will be most affected by climate change are those currently classified as dry zones, such as the northern region of Nicaragua and the municipalities in the departments of Chinandega and León, where the current programme will be sited. In these areas, higher temperatures and increasing variability in precipitation combined with more intense events will aggravate current conditions of water scarcity and extreme poverty. Under conditions of a changed climate, it is estimated that these areas will receive an average annual rainfall of 500mm, which will have significant repercussions for agricultural and livestock activities, and will also affect both water quantity and quality.

In Chinandega and León, the Estero Real River Watershed (3.690 km2), and in particular the sub watershed of the Villanueva River (1,550 km2)—also known as Rio Grande or Aquespalapa[4]—is emblematic of the combined impacts of poor development models and strong climate variability. Deforestation and inadequate land management practices, particularly in the upper and mid watershed, result in high rates of erosion and sedimentation which have already undermined agricultural productivity and threaten food security. During the wet season, landslides in the mid watershed and heavy flooding in the mid and lower watershed are common, aggravated by extreme events such as hurricanes or storms, leading to heavy losses to crops, human lives, domestic animals, damage to infrastructure and progressive deterioration of local economies. In the dry season, many superficial sources dry up and insufficient rainfall limits access to water and reduces productivity, even when there is not an outright drought. Since the region is characterized by high levels of rural poverty, coping capacities and resilience are minimal.

This difficult situation is aggravated by the reduction of surface water sources and unsustainable extraction of groundwater, which is the primary source for meeting demands, of which 74.4% are for irrigation. According to the SNC, during droughts aquifer levels can decrease by 50%, exceeding recharge and increasing vulnerabilities. This is a severe future risk, since drought events are expected to be more prolonged.

[4] In Nahual the term means “river of many fish” - an indication of the abundance that characterized this watershed in earlier times.

Diverse and growing demands for water augur future conflicts, due to increasing urban demands and intensive agricultural production, as well as efforts by small farmers to improve productivity. The situation is rendered more complex by the limited knowledge and application of land and water use practices that would promote more efficient use of water, the absence of reservoirs to manage water supply in times of drought, as well as targeted efforts to manage groundwater recharge areas.

B. The evolution of the search for rural development

After the Sandinista revolution in 1979, all Nicaraguan governments have identified the eradication of rural poverty as a priority and, with support from aid agencies, have adopted policies, established institutions and initiated programmes and projects that pursue rural economic development. Since the preparatory process of the 1992 Earth Summit and the 1994 United Nations Framework Convention on Climate Change, it has been explicitly recognized that many common farming practices pose a danger not only for the environment and natural resources, but also for the economic sustainability of the farmers themselves.

Attempts to introduce agro-ecological practices that conserve water, soil and forest have grown slowly, and in parallel with contradictory processes. It has not yet been possible to stem the steady expansion of the agricultural frontier driven by a growing population looking for land to survive by means of cutting, burning, planting basic grains, and extensive cattle ranching. The expansion has been partially supported by programmes and projects of government and international agencies focused on the urgent priority of providing livelihoods for landless farm workers, including ex-combatants from both sides of the war.

The 1970s saw the fall of a strong cotton export industry based on monoculture using agro-chemical inputs that polluted several important aquifers and poisoned a large number of agricultural workers. Nevertheless, successive governments continued to promote many practices associated with the "green revolution" and both the import of pesticides and agrochemicals and the promotion of recipes for their use have been components not only of national and international agribusiness, but also of various development programs promoted by government agencies.

The extreme event of Hurricane Mitch in 1998 destroyed much of the infrastructure in the north and west, caused flooding throughout the country, triggered landslides that killed thousands of Nicaraguans, and displaced a significant percentage of the population. The response to the event, with massive assistance from the international community, included the creation of the National System for Disaster Prevention (SINAPRED) and increased attention to the relationship between agricultural practices and the vulnerability of rural communities and soils to climate variability. Two events in the early years of this century—multiple bankruptcies provoked by a fall in international coffee prices which led to the eviction of thousands of small farmers and rural workers and a prolonged drought in the western part of the country—raised the threat of localized famines and underlined the urgency of finding ways to reduce the vulnerability of rural communities.

C. Weaknesses and efforts in institutional capacity and coordination

Unfortunately, national institutions lacked the capacity and coordination needed to tackle the challenge. Government institutions, crippled during the macroeconomic crisis of the 1980s war,

were further weakened by the International Monetary Fund's insistence on reducing public spending during the long negotiations to obtain a remission of the huge external debt, by the privatization of many public services and by the priority given to servicing a new internal debt generated when the state guaranteed deposits threatened by several national bank failures. One consequence was that the agencies responsible for rural development, the Ministry of Agriculture, Livestock and Forestry (MAGFOR), the Rural Development Institute (IDR), the Institute of Agricultural Technology (INTA) and the National Forestry Institute (INAFOR)—as well as the Ministry of Environment and Natural Resources (MARENA) and the Nicaraguan Institute of Territorial Studies (INETER)—became highly dependent on international aid funds.

One product of the prolonged need to depend on donor agencies has been national programming organized in projects and programmes of limited geographical scope and short duration. Attempts to overcome these limitations, made before and after the Paris Declaration in 2005, led to the creation of a sector program (ProRural) with the participation of MAGFOR, IDR, INTA and INAFOR, and most of the international agencies that contribute to rural development. The efforts of ownership, harmonization and alignment represented in ProRural have been significant, but until now, the topic of adaptation to climate change has been absent from ProRural programs.

D. Lessons learned in environmental, water and watershed management

It has been much easier to declare the principles of harmonization and alignment than to put them into practice. In the absence of formal sector programs for water and the environment, certain levels of coordination were achieved through the Network for Water and Sanitation in Nicaragua (RAS-NIC) and National Network of Watershed Organizations (RENOC). Some relatively long-term programs related to watershed management[5] have identified a set of important lessons that, as a whole, open a new perspective on methodology for promoting development in rural areas.

At a technical level, first of all, the effectiveness has been verified of a set of forestry, agro-forestry and silvo-pastoral practices in building vegetative cover that slows erosion and contributes to the protection of water recharge areas. Several procedures to facilitate the learning of these agro-ecological production practices have been validated, especially when there is availability of credit to finance implementation. Similarly, work has been performed on the validation of short-cycle crop varieties resistant to drought.

At the organizational level, in various micro and sub-watersheds, platforms for coordination among local farmers, municipal representatives and government and non-government institutions that support production have enabled farmers to stop being perceived solely as beneficiaries and to become partners. These organizational and perceptual accomplishments, though difficult, were achieved because water is a highly motivating theme for organization and empowerment in rural communities, especially when everyone in the community shares the same micro-watershed.

[5] These include, for example: the Socio-Environmental and Forestry Development Programme (POSAF), implemented by MARENA with IDB funds between 1994 and 2007; the Programme for Sustainable Agriculture on the Slopes of Central America (PASOLAC), executed by Swiss Development Cooperation (COSUDE) between 1992 and 2009; the Programme for Innovation, Learning and Communication for Adaptive Co-management of Watersheds (FOCUENCAS), executed by the Tropical Agronomy Center for Research and Teaching (CATIE) between 2002 and 2010.

Methodologically, an understanding and facilitating attitude by project staff has been a key factor. It takes time and sensitivity to appreciate the complex psychological, family, neighborhood, cultural and spiritual interplay that influences, as much as economic and technical aspects, the willingness of a farm family to try out new practices. The first reaction of the traditional patriarchal power structures found in rural communities is to resist change. Often there is more energy and desire for innovation among women and youth. One key to awakening local community initiative lies in promoting greater age and gender equity.

E. New national policies

During 2010, the government has adopted a national climate change strategy, created the National Water Authority, adopted a special law giving legal status to the more than 5000 existing rural drinking water and sanitation committees (CAPS), and drafted new agricultural policies based on agro-ecological principles. These four steps, discussed in section II D (see pp. 26-28 below), strengthen the policy framework for climate change adaptation and call for inter-institutional collaboration in its implementation.

F. Communities in the upper part of the Estero Real River Basin

The specific background of this programme is found in the recent history of the communities in the upper part of the Estero Real River Watershed, where factors that establish an appropriate base for social change processes are found within the traditional rural culture that tends to resist change.

With prolonged support from GTZ and the NGO Ibis Denmark, social stakeholders in the municipalities of El Sauce and Achuapa played leading roles in preparation of the Strategic Plan for Northern León and the subsequent process of negotiations with high level representatives of the executive power which led to the *Achuapa Agreements*, signed in October 2002.[6] The agreements, aimed at fighting poverty in the dry region of northern León and Chinandega, led to plans for an agro-forestry development program, production support for food security, small-scale irrigation programs and the creation of a development bank to finance production. All these items entered into the proposal made by the Government of Nicaragua to the Millennium Challenge Corporation. Another result of the *Achuapa Agreements* was the programme *Sustainable Land Management (SLM or MST, in Spanish)*, funded by the Global Environment Facility and implemented by the Ministry of Environment and Natural Resources (MARENA). The MST project addresses agricultural production with an explicit environmental focus, promoting agro-ecological practices in 10 municipalities—including those that occupy the upper Estero Real River Watershed—and enabling Municipal Environmental Management Units (UGAMs) to participate in the operational planning of government support for agriculture.

At the local organizational level, farmer associations and cooperatives are present in most communities in Achuapa, El Sauce and Villanueva. Although they are dedicated primarily to supporting their members in immediate economic matters such as purchase of agricultural inputs and selling crops, they also seek to promote practices known to be important for the

[6] ***Agreements to Implement the Strategic Development Plan in the Dry Area of Northern Leon and Chinandega,*** signed in Achuapa by the mayors of Northern Leon and Chinandega , the Secretary of the Presidency of the Republic, and other national government officials.

conservation of soil and water. Normally, each community also has a Water Supply and Sanitation Committee (CAPS).

In summary, while still sharing traditional attitudes that harbor resistance to change, communities in the upper Villanueva River basin have a history of organizational initiative reinforced by technical support from donor agencies. The degree of community organization is relatively strong, with elected local leaders in most communities, active political parties, CAPS, and religious organizations. Existing projects and programmes have provided some training in agro-ecological practices and an initial awareness of climate change issues.

G. Erosion and flooding: the upper and lower watershed

The progressive deforestation of the micro-watersheds in the upper watershed of the Estero Real River for cultivation of basic grains fed by agrochemicals has affected the ability of soils to retain water, worsening water stress in dry seasons. It has also loosened the soils themselves, generating processes of erosion in the wet season that deposit sediments in the riverbeds in the lower watershed. Although present earlier, the erosion became massive in 1998 when the rains brought by Hurricane Mitch filled all the riverbeds with large quantities of rocks, trees and soil. This raised the already flat[7] beds of the Villanueva and Gallo rivers and since then, large areas of some of the country's best agricultural land flood annually, displacing farm families, challenging the capacity of the Civil Defense in the municipalities of Villanueva and Somotillo, and threatening the genetic pool of the ancestors of maize in the Natural Genetic Reserve of Apacunca.

PROGRAMME OBJECTIVES:

The objective of the programme is to reduce risks from droughts and flooding generated by climate change and variability in the watershed of the Estero Real River. To reach the objective, the programme will rely upon a coordinated set of interventions designed to implement new public policies for addressing climate change by introducing agro-ecological practices and participatory watershed management in highly vulnerable rural communities. Through targeted investments in water retention, long-term farm planning, and institutional capacity building in local communities, municipalities and government agencies, the Programme will validate an adaptation scheme as a vehicle for implementation of the national climate change strategy. The programme will have four outcomes:

1. Reduced risk of climate induced water shortages for small scale domestic and productive uses in eight micro-watersheds in the upper watershed of the Estero real River.
2. Strengthened climate resilient agro-ecological practices for the effective use of available water in the eight targeted micro-watersheds.
3. Enhanced institutional capacities for the incorporation of climate change risk management in work plans, policies, and normative instruments in the Villanueva River sub-watershed, and the watershed of the Estero Real River.

[7] Villanueva River, for example, drops less than one meter per kilometer for a stretch of 20 kilometers in the lower watershed.

4. Disseminated results and lessons learned about building climate change resilience in vulnerable rural communities. This will be based on ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality.

PROGRAMME COMPONENTS AND FINANCING:

PROGRAMME COMPONENTS	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	AMOUNT (US$)
1. Investments in infrastructure for storing and using rain and surface water in eight micro-watersheds in the upper watershed of the Estero Real River.	Two communal irrigation systems supply family farms in two micro-watersheds. ($727,215) At least 880 rainwater collection and storage facilities supply family farms in eight micro-watersheds. ($1,650,000) At least 1000 farm families organized and trained in management, efficient use and maintenance of their communal and individual irrigation systems and water storage facilities. ($100,000)	Reduced risk of climate induced water shortages for small scale domestic and productive uses.	2,477,215
2. Introduction of climate resilient agro-ecological practices to make effective use of available water.	At least 1000 farm families with agro-ecological farm transformation plans and using their own resources and available credit for their ongoing implementation. ($132,985) At least 140 hectares converted to water-conscious and climate resilient agro-ecological production in each micro-watershed. ($1,069,800) At least 50 protected hectares in water system recharge areas and riparian zones in each micro-watershed. ($100,000)	Strengthened climate resilient agro-ecological practices for effective use of available water in the eight targeted micro-watersheds.	1,302,785

3. Institutional development and capacity building in micro-watersheds, municipalities, and participating national institutions.	Local organizations in eight micro-watersheds prepare and implement climate resilient management plans to increase water retention, soil conservation and food security. ($350,000) Inter-institutional coordinating bodies in El Sauce, Achuapa, and Villanueva coordinate governmental and non-governmental agency work plans in the micro-watersheds in the Villanueva River basin. ($40,000) Validated proposals for normative instruments to build climate change resilience and for the operation of a Villanueva River sub-watershed committee. Nine municipalities in the Estero Real River basin incorporate climate change adaptation measures in their land use, investment and water use plans and related normative instruments. ($10,000)	Enhanced institutional capacities for the incorporation of climate change adaptation measures in work plans, policies, and normative instruments in the Villanueva River sub-watershed, and the watershed of the Estero Real River	400,000
4. Ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality.	A hydrological study of the lower part of the Villanueva River basin, identifying the hydraulic works needed to reduce the flooding caused by sediments from the upper watershed. ($120,000) Ongoing participatory monitoring of water flows and quality, soil conditions, and land use changes. ($130,000) Electronic information posts in each targeted micro-watershed present relevant national and global climate information, digitalize local monitoring data, and prepare maps of land use, water flow and soil quality changes for farm families, local organizations and users of the National Environmental Information System (SINIA). ($190,000)	Disseminated results and lessons learned about building climate change resilience in vulnerable rural communities.	440,000
Programme Execution cost			450,000
Total Programme Cost			5,070,000
Programme Cycle Management Fee charged by the Implementing Entity[8]			430,950
Amount of Financing Requested			5,500,950

[8] On the request of the Government of Nicaragua, the project will be implemented by UNDP using the MIE modality. UNDP is able to provide the following implementation services through its country office, regional and

headquarters networks: project identification, formulation, and appraisal; determination of execution modality and local capacity assessment of the national executing entity; briefing and de-briefing of project staff; oversight and monitoring of AF funds, including participation in project reviews; receipt, allocation and reporting to the AF Board of financial resources; thematic and technical capacity building and backstopping; support with knowledge transfer; policy advisory services; technical and quality assurance; and troubleshooting assistance to the national project staff. Further details on the types of specialized technical support services which may be provided are articulated in the table provided to the AFB Secretariat on 14 May 2010 (see Annex 11).

PROJECTED CALENDAR:

MILESTONES	EXPECTED DATES
Start of Programme Implementation	February 2011
Mid-term Review (if planned)	February 2013
Programme Closing	February 2015
Terminal Evaluation	March 2015

PART II: PROGRAMME JUSTIFICATION

Component 1 – Investments in infrastructure for storing and using rain and surface water in eight micro-watersheds in the upper watershed of the Estero Real River.

The uppermost part of the Estero Real River Watershed is composed of micro-watersheds whose waters flow into the Villanueva River. During the dry season, the communities that live in these micro-watersheds suffer severe water stress. Droughts are a recurring threat, particularly due to the events caused by the El Niño phenomenon. In the wet season, and particularly during the La Niña events, the decreasing capacity of the soils to absorb and retain water facilitates erosion and causes flooding. In a vicious cycle, dry soils lose the vegetative cover that breaks the fall of water and thus permits infiltration: when the rain does arrive, it falls directly on unprotected soil, running off too quickly to penetrate the soil well, thus causing erosion. These soils, washed downstream by tributaries of the Villanueva River, are then carried to the lower watershed by the Villanueva itself where they raise the floor of the riverbed and augment annual flooding.

To break this vicious cycle and prepare to face the increasingly varied rainfalls expected over the upcoming decades, the communities in each micro-watershed need to retain as much rainfall as possible. Unless there are changes in agricultural practices, organic matter will continue to be lost as the topsoil of the micro-watersheds travels ever more rapidly toward the lower watershed. At the same time, if water is not retained in the upper watershed it will not be possible to introduce the agro-ecological practices needed to replace the lost organic matter in the soil.

Traditionally, in these micro-watersheds, two harvests of basic grains have been expected each year. The *primera* (“first”) is planted in time for the crop to be fed by the rains of April through July. After a brief dry season known as the *canícula* (“dog days”), a second crop, called the *postrera* (“final”), is planted. The *postrera* is the most important crop because of the heavier rainfalls which occur between August and November. On several occasions during the past few years, however, local farm families have experienced the total loss of both crops. The losses occur not only when El Niño brings extended dry periods, but also when the rains unexpectedly fail during critical moments in the crop cycle.

Farm families in the area are motivated for change because of the repeated experience of losing crops. Their subsistence depends on their capacity to guarantee at least one harvest per year. They are willing to contribute with the resources they have, including their time and labor, to build small hydraulic works that will allow them to retain the necessary water to

guarantee food for their families. This in itself will obviously not be enough to reverse the ongoing processes of soil degradation and erosion. It is, however, an essential precondition for the introduction of agro-ecological practices in Component 2.

The resources of the programme are insufficient to finance small hydraulic works for all the farm families in the upper watershed of the Estero Real River. In order to maximize the environmental impact of improved water retention, the programme will concentrate its resources in eight micro-watersheds located at the highest parts of the Villanueva River sub-watershed in the municipalities of El Sauce, Achuapa and Villanueva[9]. All eight suffer from acute water stress; five are in areas with traditionally lengthy "dog days", now often extended into drought (see map 8); four are in areas with among the lowest average annual rainfall in the sub-watershed (map 49. All eight are located in areas characterized by agricultural overuse of soils more apt for forestry (maps 10-12).

Two of the micro-watersheds were chosen because they contain year-round sources of surface water appropriate for communal irrigation systems (***output 1.1***). The other six were selected for rainwater collection and storage facilities (***output 1.2***) by the Municipal Environmental Management Units of the three municipalities because of the geographic, climatic and land use factors mentioned above. The agricultural cabinets and other participants in the inter-institutional planning processes of the three municipalities concur with the selection since the communities in all eight micro-watersheds are considered to be amenable to organization and training in order to make good use of these investments in local infrastructure to harvest rainfall and use surface water (***output 1.3***).

The eight micro-watersheds are[10]:

Municipality	Micro-watershed	Communities	Farm Families
El Sauce	*Las Mercedes*	Mercedes Centro Cooperativa El Borbollón	80
	Salale	Salale La Montaña La Montañita Ojochal	130
	Petaquilla/Campamento	Campamento Petaquilla	140
El Sauce & Achuapa	*Varela*	San Antonio 2 Varela	80
Achuapa	*Coyolar*	El Pajarito El Guanacaste Las Brisas Las Lajas	150

[9] See Annex 1, map 1, for the location of each sub-watershed of the Estero Real River. See maps 2 to 7 for the location of the three municipalities and the eight rivers or streams of the targeted micro-watersheds in the Villanueva River basin.
[10] Final determination of the communities and farms in each micro-watershed is subject to confirmation at project start-up.

	El Cacao	El Lagartillo El Waylo El Rodeito San Nicolás	145
Villanueva	*El Genízaro*	El Genízaro	135
	El Pilón	Las Brisas El Moto La Concha Pitahaya	145
Totals	8	24	1005

a. Irrigation systems in Las Mercedes and Salale Micro-watersheds (output 1.1)

Preparatory and final design studies have been completed for construction of irrigation systems fed from micro-dams on year-round streams found in the micro-watersheds of the Las Mercedes and Salale rivers. Both are located in the Municipality of El Sauce, close to the uppermost part of the Villanueva River sub-watershed. A consultation process with local communities took place in 2008 while the design studies[11] were underway with funding from the Millennium Challenge Account-Nicaragua. As a result of these consultations, two irrigation associations were defined and agreements were reached about their creation and operation once the systems are built. The agreements include outlines of procedures for the prospective assignment of water rights.

a.1 Las Mercedes

The works designed for Las Mercedes Micro-watershed include two water inlets. One is located in Mercedes Centro area, where there is currently a gravity irrigation system used by 17 farmers. The other is located farther below, where 11 members of the Ismael Castillo Cooperative make use of a water intake that requires rehabilitation. Through these two intakes, with their respective complementary facilities, it will be possible to:

- Irrigate a total area of 137.55 hectares per year instead of the 56 that currently have some irrigation;
- Implement a drip irrigation system in Mercedes Centro[12];
- Improve the surface irrigation system in Cooperativa;
- Guarantee water supply during dry spells;
- Operate collective clothes washing facilities.

The elements of the Mercedes Centro system include:

- A zip type intake installation, 2.7 effective meters in width, on Las Mercedes River near the community of El Borbollón, to collect 30 liters of water per second. The installations include a sand trap, a surplus spillway, and a canal segment where a gauge will be placed.
- A water shunt along the right river bank through a cyclopean concrete channel.
- Construction of 2.6 miles of buried pipes for water pressure supply.

[11] See Annex 3 for the Las Mercedes study. The Salale study is similar.

[12] The original design (see Annex 3) included a sprinkler system. This will be changed to a drip system in keeping with the agro-ecological principles guiding the project, thereby increasing the number of hectares that can be irrigated throughout all months of the year, including the dryest.

- 18 hydrants with flow valves for the delivery and regulation of the water directly to farm plots.
- Construction of a network of 1.07 km of secondary pipes.
- A pressure-break chamber.

The elements of the irrigation system in the Cooperativa sector include:

- Rehabilitation of the existing intake structure with better hydrodynamic conditions, and construction of a new output channel.
- Protection works in the water collection area.
- Covering of 1.12 kilometers of the channel, with a design flow of 50 liters per second, to reduce water losses by percolation.
- Construction of two vehicle bridges.
- An 8 meter aqueduct.
- Construction of 4 irrigation distributors.

For the cattle farmers and domestic use, the Cooperativa system will add:

- A reinforced concrete tank with a capacity of 25 cubic meters.
- Water troughs for cattle.
- Construction of collective clothes washing facilities.

With these installations, the beneficiaries of the Las Mercedes micro-watershed irrigation systems will be:

SECTOR	Beneficiaries		Total
	Current	New	
Mercedes Centro	17	25	42
Cooperativa Ismael Castillo	11	3	14
Cattle farmers	0	9	9
TOTAL	**28**	**37**	**65**

The 2008 preparatory and final design study (Annex 3) estimated the construction costs of the installations to be US$ 256,962, of which US$ 25,865 would be the contribution of labor provided by the beneficiaries and US$ 231,098 the donor's contribution. It was also estimated that, in addition, consulting services would be required to supervise the construction works and to support system users in providing their counterpart labor contribution. The cost of the consulting services was estimated at US$ 167,600, indicating that the total contribution of the donor would be US$ 398,698.

As part of the preparation of this programme Document, a review of the design and estimated costs[13] was undertaken to determine if it would be necessary to make adjustments to the cost estimates before tendering the works once the programme begins, taking into account the time elapsed since 2008 and changes in the institutional context. The review determined that

[13] See Annex 4

the devaluation of the Nicaraguan currency and inflation of certain costs justify a new estimate of the donor contribution for construction at US$257,464. It was observed, however, that significant savings could occur in the consulting services for works supervision and user support because it will be possible to combine them in one contract with the consulting services for the same purpose in the Salale micro-watershed.

There are 80 families located in the Las Mercedes micro-watershed, all of them users of the drinking water and sanitation system. To enable all of them to improve their access to water for productive and/or domestic purposes, as part of output 2 some US$ 30,000 will be allotted for additional small hydraulic installations for collection of rain water on those farms whose location does not allow a connection to the irrigation systems.

b.2 Salale

The irrigation system designed for the Salale micro-watershed will convert some eight existing individual micro-systems capable of irrigating 11.55 hectares into a community system for 20 families, capable of irrigating 24.5 hectares and tripling the annual net income from agricultural production in an area considered important for feeding the urban population in the Municipality of El Sauce.

The elements of the Salale system include:

- Construction of a 1.1 kilometer temporary access road.
- A water storage installation on the Salale River in a natural cascade located in the community of Ojochal.
- A 2.0 to 2.5 meter wide platform on a rocky slope in order to install a 640 m concrete channel in the direction of the left bank of the river.
- Excavation of a ditch 6.0 meters deep for a water crossing.
- A 48 meter arched channel for the water transfer.
- Construction of a passage across a gully and an aqueduct of 8 feet in the water channel.
- A holding chamber, at the outlet of the arched channel, from which the main pipeline network will be loaded.
- A network of pipes buried at no less than 50 cm to work with pressure, with one branch located on the upper part of the agricultural terrace on the left side of the river and a second for irrigation on the right side of the river.
- A series of 11 hydrants to deliver and regulate water directly to the plots of land.
- A 22 meter hanging bridge on the right side of the irrigated area.

The preparatory and final design study[14] estimated construction costs for this system at US$ 280,297, of which US$ 20,122 would be the labor contribution of the beneficiaries and US$ 260,175 the contribution from the donor. In addition, it was estimated that the consulting services costs for works supervision and user support would be US$169,200, so the total donor contribution would amount to US$ 429,375.

[14] GFA Consulting Group, Final Report, Irrigation Systems Salale. Millennium Challenge Account-Nicaragua. September 2008.

The current review of the design and estimated costs[15] raised the estimated donor contribution for the works to US$ 288,851. Nonetheless, the consulting services to supervise the works could be combined in the same contract with the supervision of the works in the Las Mercedes micro-watershed for a total cost of US$ 180,900. Consequently, the combined estimate of the amount necessary for the micro-dams and irrigation systems in the two micro-watersheds of Salale and Las Mercedes is US$ 727,215.

As part of output 2, about US$ 70,000 will be allotted for small additional works to allow families in the Salale micro-watershed that do not have access to the irrigation system from the river to collect rain water for agricultural production and/or domestic purposes.

b. Rainwater retention in the other six micro-watersheds (output 1.2)

It is anticipated that in six of the micro-watersheds, structures of an appropriate size will be built for individual farms, or for small groups of 2 to 4 neighboring farms. Building on the experience of the Sustainable Land Management Project (MST) with selected farmers in El Sauce, Achuapa, Villanueva and 7 additional municipalities in the area, and the analysis of other experiences in Nicaragua, a "menu" is available with five types of minor hydraulic infrastructure that can be installed on individual farms. Selection of the structure appropriate to each farm will be made on the basis of agro-ecological farm transformation plans prepared to determine the most appropriate agricultural production practices for the soils, slopes, and current soil cover of the land, as well as the capacities and interests of the farm family. The dimensions of each structure may vary to adjust to the physical conditions of the specific plot. The basic menu[16] is:

Water storage structure	Typical dimensions	Volume	Estimated cost/m3
Brick lined cistern well	2m * 3m	9.42 m3	$ 69.00
Roof collection system	varies according to size of house		$ 37.00
Polyethylene lined pond	6m * 5.7m * 1.2m	41.00 m3	$ 7.00
Polyethylene lined trench	31m * 1.8m * 1.3m	54.00 m3	$ 5.82
Reservoir with dikes	6m * 10m * 1m	60.00 m3	$ 5.85

In principle, US$ 250,000 will be allotted to each of these micro-watersheds to contribute to the construction of rain water retention structures. The most effective manner of using these resources in each micro-watershed will be determined during the first year of the programme. A requirement for investment will be the preparation of an agro-ecological farm transformation plan by the farm family, specifying forestry, agro-forestry and silvopastoral practices that will be adopted (or reinforced) to optimize the benefits of the stored rain water.

In principle, the economic efficiency of a structure is higher when its total volume increases. Structures—such as cistern wells and roof collection systems—that by their nature have limited

[15] See Annex 4.
[16] See Annex 2 for specifications and costs of different types of rain and surface water retention structures.

dimensions are significantly more costly per cubic meter than structures whose dimensions can be extended. Consequently, the benefits tend to be higher where several farm families with neighboring plots agree to share a larger size pond, lined trench or micro-reservoir. It must be noted, however, that the physical efficiency of sharing a larger structure is accompanied by organizational difficulties that are inherent to communal works. During the first year, efforts will be made to optimize the efficiency of the investment, looking for the point of equilibrium between the larger physical benefits of structures with higher volumes and the organizational difficulties that these can entail.

In the selection of works to be built in each micro-watershed, not only the water collection and storage structures will be considered, but also investments in soil and water conservation works to increase the recharge rates of aquifers through, for example, infiltration ditches and fences to protect forest regeneration areas. These investments will be complemented by agricultural works such as drip irrigation systems, contour line ditches and other agro-ecological practices promoted in Component 2.

c. Organization and training for water works management (output 1.3)

For construction of the works in the eight micro-watersheds, the municipalities of El Sauce, Achuapa and Villanueva will sign agreements with MARENA establishing financial mechanisms for the transfer of funds to be used in the construction of the hydraulic works.[17] Contracts for construction of the irrigation systems as well as the rainwater collection systems will require the contractors to work closely with the beneficiary families, incorporating their labor during construction and providing them with training in the management, efficient use and maintenance of the hydraulic systems. The civil engineer on the programme team will collaborate with municipal procurement staff to ensure that this training is provided properly. In addition, for the irrigation systems and wherever rainwater collection systems require organization involving neighboring farm families, the programme Coordinator will also oversee the training provided by the works contractors to ensure that it covers all organizational issues appropriately and that there is appropriate follow-up through Components 2 and 3, once the construction contracts have ended.

Component 2 – Introduction of climate resilient agro-ecological practices to make effective use of available water.

Climate change represents a serious threat to agricultural activities due to the close relation that exists between water and soil resources. Prolonged droughts weaken the biological basis of soil structure, and prolonged torrential storms erode weakened soils. To break the cycle of growing vulnerability in the communities in the Villanueva River basin, the hydraulic works financed in Component 1 will be important but not sufficient. To be effective, they must be selected, designed and used as tools in a series of fundamental changes in the activities of agricultural production. These changes must ensure more efficient use of water in all production processes, increase infiltration, strengthen soil structure, and stabilize slopes.

a. Agro-ecological farm transformation plans (output 2.1)

[17] See Section III-A below, especially p. 38.

The decisions and work required to introduce the changes needed in production practice can only take place at the individual farm level. Consequently, the most important planning process in this component will be the preparation of detailed farm plans for the progressive introduction of agro-ecological practices.

The priority activity during the first year of the programme will be the preparation and/or updating of a farm transformation plan by each farm family in each micro-watershed. The basic elements for each farm transformation plan will be:

- Identification of the vocation of the soils on the farm.
- Diagnosis of current practices, including the use given to all land and available water.
- On the farms benefiting from the irrigation systems designed for Las Mercedes and Salale micro-watersheds, identification of the potential production options afforded by the irrigation system.
- On the other farms, identification of feasible water collection alternatives, a reasoned selection of the preferred option(s), and identification of new productive options that will arise.
- Design of the future use of all land and available water, applying agro-ecological practices.
- A long term transformation strategy.
- A 1 to 3 year transition plan
- A proposal for immediate implementation, specifying the following elements:
    - selected rainwater retention facilities and, where applicable, drip irrigation system installations;
    - household installations and procedures for optimizing water and fuel use;
    - household investments for family nutritional security including home gardens and, where appropriate, small animal management;
    - application of a selected agro-ecological production process on 1 hectare of farm land.

The programme will place a great deal of emphasis on these farm transformation plans, and especially on facilitating their full appropriation and active use by each farm family. To this end, personalized and patient attention will be dedicated to each family; the programme will finance materials for initial plan implementation; the pertinence of the plan and/or any necessary adjustments will be confirmed before each technical assistance activity. During years 2 to 4 of the programme, transformation plan updating sessions will take place at least once a year and farm families will be assisted in applying for financing to ongoing implementation. In the event that some farm families do not prepare transformation plans in the first year, they will be offered support for their preparation in each subsequent year of the programme.

b. Menu of Production Practices (output 2.2)

In order to increase the capacity of each farm to adapt to climate change and variability, the programme will offer technical support as well as vegetative and construction materials needed to carry out the changes involved in the adoption of a “menu” of agro-ecological practices. Each farm family will be assisted in identifying appropriate practices to be included in their farm

transformation plan, selecting them not only from printed descriptions, but also – in many cases – from ongoing examples: a "buffet" that illustrates the "menu". This will be possible because in each of the three municipalities there are a number of farms that have already received support from the programme "Sustainable Land Management" (and/or from other technical assistance programmes); each farm family in the targeted micro-watersheds will be offered the opportunity to visit nearby sites where several recommended practices are under way.

Annex 5 provides a summary of the information about the practices included in the menu. The programme will supply validated information about the procedures, investment costs, and conditions required for:

- practices that protect underground water resources. These include:
    - reduction in the use of agrochemicals for different production practices.
    - production and use of organic fertilizers and botanical insecticides.
    - integral crop management with biological, physical and manual control of crop health.
- practices to reduce the risk of harvest losses during drought periods. These include:
    - adoption of climatically adaptable crops,
    - adoption of higher value crops,
    - changes in the production calendar and review of planting dates,
    - use of short cycle varieties,
    - use of drought resistant varieties.
- practices to increase the benefits of available water. These include:
    - climatically adaptable irrigation methods,
    - efficient practices in the use of irrigation water.
- practices that minimize the impact of animals on the topsoil. These include
    - use of leguminous fodder trees,
    - animal feed alternatives,
    - improved livestock feed storage facilities.
- communal and individual practices to protect water table recharge areas, stop erosive processes, increase underground water infiltration, and reduce the risk of landslides (***output 2.3***). These include:
    - delimitation and preservation of natural regeneration areas,
    - maximization of plant cover on cultivated plots,
    - participation in the efforts of the local authorities to prevent and reduce fires.

c. Transformation plan implementation (outputs 2.1 and 2.2)

The first farm transformation plans should be ready 3 to 4 months after programme start up. Programme support will be provided for the elements in the proposed plan for immediate implementation, provided that:

- a member of the farm family has a property title or good faith possession[18] of the farm;
- the farm is not located within a protected area;
- the farm is located within one of the targeted micro-watersheds;
- the farm family does not receive public financing from another entity for the same activity;
- the elements in the immediate implementation plan are judged by the programme outreach worker assigned to the micro-watershed as legitimate steps towards the full agro-ecological transformation of the farm.

Some of the elements in the proposal (such as the construction of a low consumption stove, for example) will be possible to implement at any time. Others (such as construction of rainwater retention structures) will not be advisable during rainy periods. Yet others (such as adapting a hectare for planting under a new agro-forestry system) will need to be timed to begin with the preparation for the final crop (the *postrera*) of the first year or the first crop of the second year. The programme team will endeavor to ensure that the required materials and technical assistance are available in each micro-watershed at the appropriate times.

Care will be taken to ensure that implementation occurs at a speed conducive to quality and full appropriation by the farm family, even if this means that some elements included in the proposal need to wait until the following year. Respect for the absorptive capacity of the family will also guide the completion of the farm transformation plans. The first annual programme work-plan will specify the technical assistance inputs to be made available in each micro-watershed, but it will not establish quantitative targets for the number of immediate implementation proposals that should be carried out during the year. Implementation targets will be established for the second and—if necessary—the third year of the programme, following analysis of the implementation rhythm achieved in each micro-watershed during the first year.

While seeking to ensure that the benefits of the programme are available to the farm families as soon as possible, the programme team will also give a high priority to ensuring that each investment made on a farm is not seen as an end in itself but rather as a step toward the full agro-ecologic transformation of the farm, and, therefore, part of a long term process which will depend on the attitude, understanding and commitment of the farm family.

When properly appropriated and carried out, agro-ecological practices will generate secure harvests, higher crop yields, and increased income—along with stable soils and greater water retention. This will stimulate farm families to continue with the implementation of their 1-3 year transition plans and their long-term transformation plans. If, on the other hand, innovations are imposed or pushed through to meet programme targets they will be less likely

[18] As defined in the Nicaraguan Civil Code.

to provide solid benefits to the farm families and they may be abandoned once the programme is over.

d. An innovative mentality (outputs 2.1, 2.2 and 2.3)

Through the process of preparing farm transformation plans, consideration of the menu of production practices, visits to the buffet of ongoing practices, implementation of the transition plan, and regular updating of farm plans, the programme will seek to induce an innovative mentality in farm families. Agro-ecological technical assistance will be accompanied by a broader educational process, with three areas of focus. Overall, it is anticipated that awareness in these areas will stimulate the adoption of proactive behaviors to adapt to already experienced climate variability, and also to proactive attitudes for ongoing learning about future climate change effects.

One area of focus will be **the climate change process itself**. Farmers in the area say they have heard many references to the greenhouse effect and the impacts being generated on the Earth, but they lack clear information that enables them to understand the whole process and its relationship to their own lives. Through the activities of component 4, the communities of the targeted micro-watersheds will have access to relevant information managed by the Nicaraguan Institute for Territorial Studies (INETER) and the Climate Change Directorate of MARENA, including the first and second national on climate change[19].

A second area of focus will be **agro-ecological**. Taking into account both the new national agro-ecological policy focus as well as university courses already underway in this field, farm families will be placed in contact with agro-ecology technical specialists and students during the development and implementation of their farm transformation plans. It is anticipated that this will have the effect of introducing a practical action-research perspective that promotes testing a combination of traditional practices with advanced technology. If they assume this perspective, farm families will assess their innovations on the basis of their success in producing healthy and good quality food, through respectful techniques in harmony with the environment. In particular, the programme will communicate ways to **replace the use of agrochemicals** with organic biological processes aimed at reducing pollution in water bodies, soil and air, and also minimizing production costs while increasing the nutritional and economic value of produce.

Applying in depth national policies that value the role of women in rural areas, emphasis will be placed on the importance of integral practices in production systems that encourage **family involvement**. In each micro-watershed, a series of workshops[20] will be held to stimulate analysis of the roles played by men, women, youth and children in the production process and the family economy, valuing household work, marketing of products and home garden production. This will aim at promoting just relations and solidarity among men and women, adults and youth, creating the conditions and values that enable more equitable capacity development and role distribution among family members. It is anticipated that this will also have the effect of releasing the energies latent in farm families, and that women and youth will drive changes in favor of ecology, nutrition, food security, food sovereignty, and biodiversity.

[19] See pp. 21-22 below
[20] See Annex 10 for a discussion of gender and family role workshop methodology.

e. Agents of change (outputs 2.1, 2.2, and 2.3)

The success of the programme will depend on the capacity of the technical team to induce and accompany a critical mass of changes in production systems, sufficient to generate appreciable effects in water availability and soil conservation. To this end, the resources provided in Component 2 will be aimed not only at the adoption of agro-ecological practices but also at establishing a close relation between farm families and the sources of the support they will require for successful long-term application of such practices.

One part of the Component 2 input will be economic. In principle, the programme will allot US$ 146,225 to each micro-watershed to support the adoption of new conservation and agro-ecological practices[21].

These resources will accompany an intensive and carefully designed human input in each micro-watershed. As expressed in the discussion of implementation arrangements[22], a careful selection of the professional staff for the programme team will be made, aimed at guaranteeing the staff's technical and social capacity as promoters of change. The programme team will coordinate closely with staff from pertinent national government institutions (MAGFOR, INTA, IDR, and MARENA), municipal governments, cooperatives, farmer organizations, churches of different denominations and the NGOs that are active in the micro-watersheds.

Particular attention will be given to ensuring the timely participation of leaders in the national agro-ecological movement, since their experience as farmers whose success with agro-ecological practices makes them particularly effective communicators of the importance and possibility of farm transformation. To this end, the programme will allot $55,800 to cover their expenses in workshops with farm families.

In addition, developing a recent experience of the Nicaraguan Institute of Agricultural Technology (INTA), the programme will facilitate agreements between INTA, the Faculty of Science and Technology of the National University of Nicaragua (UNAN-León), the Faculty of Anthropology of UNAN-Managua and the municipal governments of El Sauce, Villanueva and Achuapa, so that senior students, both of agro-ecology and anthropology, undertake work-study activities in the micro-watersheds.

Each micro-watershed will be assigned 4 students of agro-ecology for 3 months each year. Teaming up with INTA staff and the programme team extension workers, these students will enter into direct relationships with farm families to provide support for them in developing, implementing, monitoring and annually updating agro-ecological farm transformation plans. To support their participation, US$ 150 monthly will be allocated for the expenses of each student during the three months that he or she will live in his or her assigned community each year. Community families will be asked to commit to provide the students with room and board for a reasonable charge during their stay. In this way, while ensuring close contact with farm families, cash resources will be injected into the community economy.

An anthropology student will accompany each team of agro-ecology students. With technical support of INTA professionals and coordination and advice from the extension staff on the programme team, these student teams will function as agents of change in the communities

[21] See Annex 5 for a summary of costs related to adoption of various agro-ecological practices.
[22] See pp. 37-42 below

where they will share in the lives of the farm families for 3 months of the year. Their presence is expected to facilitate the involvement of families and communities in different measures of adaptation to climate change and so that they can attain ownership and empowerment.

f. Added value for climate change adaptation

The proposed Programme outputs under Component 2 have a definitive additional value for two reasons: i) focus is on the development of practices and skills that go beyond "traditional" sustainable land use management (SLM) approaches; and ii) these constitute part of a comprehensive effort to ensure that the investments made under Component 1 are maximized.

SLM approaches deliver a range of benefits which include enhanced resilience and stability of ecosystem services and functions and it can thus be argued that these practices contribute to reducing vulnerability to climate variability and change. However, specific activities will be promoted that go beyond traditional SLM approaches and which seek to address the existing and projectedd climate stresses and that specifically seek to strengthen the coping capacity and options of local communities and livelihoods. These include adoption of crop varieties that are more climate resilient, changes in crop cycles to account for climatic variability during the wet season, and promotion of livestock feed facilities for times of drought. These are not "traditional" SLM nor development objectives.

Notably a key programme goal that underpins Component 2 is to contribute both to improving water availability and to the promotion of water use efficiency in order to complement the investments being made under Component 1. With regards to the former, aquifers constitute critical resources for drought-stricken areas. However, there are concerns that aquifers in the programme area are being overexploited and Government authorities are keen to support activities that will enhance groundwater infiltration rates. Such activities which include improved catchment area protection efforts will also contribute to slowing down erosion rates and therefore limiting the risk of landslides, a recurrent threat during the wet season. The understanding that aquifers are essentially natural water storage facilities also drives the concerns to ensure that these critical resources are not polluted from excessive agro-chemical use. Thus some of the activities under Component 2 seek to protect groundwater resources – as part of a long-term adaptation strategy - both in terms of water quantity and water quality. With regard to water use, under Component 2 approaches that encourage more effective water use will be promoted. These include climate resilient irrigation approaches – which are critical so as to make the best use of increased water availability through investments under Component 1.

The programme will work closely with the municipal planning, environmental and water and sanitation units, as well as with the departmental MARENA office, in order to define the baseline and further characterize risks related to the effects of climate change. An important tool that will aid this process is the national system of environmental indicators (SINIA), which will also be strengthened to incorporate climate change considerations under Component 4 (see below).

Component 3 – Institutional development and capacity building in micro-watersheds, municipalities, and participating national institutions.

To adapt to climate change, human beings have to develop new capacities and forms of social organization. To be able to respond to the effects of climate change that have and will have the greatest major impacts on our lives, the core issue is water management.

Water management, as recognized by Law 620, the General Law of National Waters, requires organization that is structured in terms of watersheds, at the watershed level and at the levels of the sub-watersheds and micro-watersheds that make up the 21 watersheds of Nicaragua.

The national experience in watershed management is limited, but it has generated lessons at the level of micro-watershed and sub-watershed management that are very important for this programme. Based on the scientific information available (geographical, hydrological, weather, agricultural and forestry), it is possible to elaborate an ideal design for water management and soil conservation in a micro-watershed and for the set of micro-watersheds that make up the sub-watershed. An ideal master plan, however, will have no effect if it is not appropriated by the population that lives in each micro-watershed. The decisions of the local population are what determine how water and soils are used. And for local stakeholders to make use of a plan to guide their decisions, they should participate in its preparation.

To participate effectively in the preparation of micro-watershed and sub-watershed plans, the local communities need access to the pertinent scientific information. They also need a forum where they can examine the information, compare it with their own experience, debate its implications, examine the options for action, consider the consequences of each option, verify the intentions and will of their neighbors, and make decisions.

This forum cannot be a single workshop, or a series of planning workshops, that conclude with the “approval” of a plan for the micro or sub-watershed. Participation in a verbal or written agreement does not change behavior on the ground. A permanent forum is needed to allow for reflection about the results of the first new actions undertaken by the community or by some of its members, consideration of other initiatives stimulated by the results of the first, and an assessment of the new situation created. Management of the transformation of agricultural practices in a micro or sub-watershed is—necessarily—adaptive: adaptive not only to climate changes but also to the changes generated in and by the activities of the participating local families themselves.

Adaptive management is also—necessarily—co-management. Not only local stakeholders participate in it, but also the promoters of the management process, the agents of change in rural development. They are not the generators of the scientific information about the watershed, but initially they are the ones who know how to obtain that information. These are the technical specialists in management of water and other natural resources, the extension workers and local and national government planners and professionals who work in cooperatives, professional organizations and NGOs active in the area.

Component 3 is the key component; it is the core of this programme. Its inputs consist of actions designed to create and/or strengthen bodies for adaptive co-management in the eight targeted micro-watersheds and the Villanueva River sub-watershed, and for participation in adaptive co-management of the Estero Real River Watershed. These bodies–equipped with the required capacities and appropriate instruments for their respective contexts–will be the crucible where local will and experience meet and interact with national institutions and policies, and pertinent scientific knowledge.

Experience in Nicaragua and in other parts of Central America has shown the importance of creating adaptive co-management bodies in order to advance toward integral management of a micro or sub-watershed. It has not generated a prefabricated recipe for their creation. There are several strategies under construction; each new initiative contributes new knowledge; this programme will also contribute to the development of the adaptation process.

a. Capacities, organization and co-management in the micro-watersheds (output 3.1)

This programme proposes to effect deep changes in the water use behavior of agricultural producers and water consumers in eight micro-watersheds, both in agricultural practice and in domestic use, with the purpose of guaranteeing food security.

Some years ago, farmers in the upper part of the Villanueva River basin used certain natural *señas* ("weather signs") to guide their harvest plans. Today, these signs are not sufficient. Changes in rain patterns with ever more frequent, longer, and more intense periods of flooding and drought, place human life and food security in danger, making different economic and production activities more vulnerable. At the community level, the farmers with most expertise in reading the *señas* of change in the seasons have noted that these are no longer as reliable as in the past. Now, they accompany this verification with a new indication: *cultivate as soon as rain falls and not when the señas appear*. Climate changes have made it necessary to leave the language of *señas* behind.

Despite this loss of faith in traditional knowledge, a collective search for new patterns of knowledge has not been generated. There is uncertainty and insecurity, but these have not generated social processes for reflection and change in the face of greater variability in ENOS events. To generate such processes, the programme will facilitate the creation of a body for adaptive co-management in each micro-watershed.

The co-management body to be created may be called, as Law 620 indicates, a "micro-watershed committee", but it may also be a product of the evolution and strengthening of an existing organization. The important factor, as a starting point, is that it recognizes, respects and facilitates the incorporation, as programme partners, of the existing organizations, such as the drinking water and sanitation committees (CAPS), organizations of farmers and irrigators, community committees, citizen power cabinets, women's groups, youth groups, religious organizations and other organizations that are present.

It is equally important for the programme that the process of organizational evolution be accompanied by a culturally digestible learning process. Generally, farmers make their decisions while thinking from their property boundaries inward. Technical specialists are also accustomed to planning actions for the farm's production system. The micro-watershed approach requires changes in the way farmers and technical specialists reflect, rationalize and make decisions.

People should adapt to sharing, making and accepting communal decisions about various aspects of the use and management of their natural resources—in the past this was an individual concern. This may be a long term process, in which it is necessary for extension workers, technical advisors and farmers to continually emphasize certain important factors as a way of inducing the beginning of a change process.

The most important factors are:

- **The farm is not isolated**. Farm families need to become aware of the fact that the farm is not isolated but is rather part of the micro-watershed. It influences this larger landscape and is influenced by it. If inhabitants are not clear about this relation, it will be difficult for them to coordinate actions to correct the existing problems in the micro-watershed.
- **Everyone is responsible**. It is common for farmers to blame neighbors or other people for the damages or bad agricultural practices that affect the environment. Hardly ever do they feel responsible and, in consequence, they do nothing different that would involve a process of ongoing and environmentally attuned change. Action at the micro-watershed level requires awareness of the fact that everyone is responsible and that important impacts will be attained only if the majority (ideally everyone) take action jointly.
- **Decision making:** One of the most complex processes to be implemented together with the farm families in the micro-watershed is to enable them to identify themselves as a community that can work as a team and begin to make joint decisions for the management of the natural resources located on their lands. The population is accustomed to making shared decisions for infrastructure (schools, clinics, transportation, communication, security, etc.), where the action does not involve changes in the use and management of their own personal properties: their fields, their production system, their farms, and of course, their costs and incomes. The micro-watershed plan will only be feasible when the local population is willing to make and accept communal decisions. To begin with small actions of interest to the majority can be the shortest path to inducing awareness that can generate the necessary social change.
- **The need to organize:** Making decisions and implementing shared actions at the micro-watershed level requires organization. It is, however, necessary to organize for a purpose and not as an end in itself. In this sense, the organization must be viewed as a tool to reach objectives that are not accessible for individuals on their own.

The aforementioned gap in the traditional reliance on "weather signs" can be an open door for the start of this learning process. Through the actions of Component 4 communities will be provided with new sources of information relevant to their agricultural decisions[23]. Institutions, local governments and the population can join in studying this information in preparation for facing the risks of climate variability.

The central issue in the generation of the required organizational change is likely to be the interaction between climate change and water availability. Most communities already have some experience with organization to address the issue of water. It can be particularly strategic to strengthen (or in a few cases, to organize) the local Water Supply and Sanitation Committees (CAPS) which in fact already function as social structures that collectively manage the use of water resources for human consumption. In some micro-watersheds, there are also irrigators' associations that manage water for agricultural purposes. It is possible that the micro-watershed committee will be born as an extension of the functions of a CAPS or out of coordination between a CAPS and an irrigators' association.

The process of establishing a micro-watershed committee should not be hastily forced. The development of farm transformation plans in Component 2 will initiate changes in the

[23] See pp. 21-22 below

perception of farm families; the introduction of new sources of information and a detailed understanding of the dynamics of interactions in the sub-watershed in Component 4 will stimulate an expansion of perspective; the implementation of the investments in Component 1 will show that notable changes in access to water are feasible. The analysis of the effects of these interventions on attitudes, intentions and behaviors in each micro-watershed should contribute to the programme team's decisions about the pace of its organizational interventions.

It is possible that in some of the micro-watersheds, the creation of a watershed committee will be achieved in the first year of the programme. The goal will be to have a co-management body in operation in each targeted micro-watershed by the end of the second year.

The main tool for adaptive co-management of the micro-watershed will be a climate resilient micro-watershed management plan to increase water retention, soil conservation and food security. The plan should address water use and protection, soil conservation and enrichment, and land use regulation, reflecting current reality, a shared vision of what should be, and a transition plan covering a timeframe determined by the community. The monitoring plan of the micro-watershed plan will be fed by monitoring reports about farm plan implementation, irrigation and drinking water systems operation and development, and collective activities for the protection of recharge areas and / or conservation. The first version of the co-management plan for each micro-watershed should be prepared no later than the first semester of the third year of the programme to ensure that by the end of the programme the micro-watershed committee has had at least one year of experience in its implementation, monitoring and updating.

In recognition its central importance, Component 3 will be coordinated directly by the Programme Coordinator. The terms of reference for this position[24] require that the person concerned be an anthropologist, sociologist, social psychologist, an adult educator or a professional in another related field, with expertise in facilitating organizational and learning processes in rural communities.

In addition to the technical team and professionals from the central government institutions (MARENA, INTA, MAG, and IDR) and municipal governments with responsibilities in the area, the coordinator will have the support of students from the anthropology faculty in the UNAN-Managua. These anthropology students, as well as the agro-ecology students who will support the programme in Component 2, will work within the institutional context of their university's agreement with INTA. INTA has found that anthropology students enhance the appropriation of agricultural technologies since they study the processes that create social behavior and that can lead to change and improvement in a community.

b. Capacities, Organization and Co-Management in the Villanueva River Sub-Watershed (outputs 3.2 and 3.3)

This programme should generate behavioral change, not just by the communities, but also by the staff on the facilitation team and the staff of the national and municipal institutions involved in the programme. To generate this process of change the programme will develop an organizational framework that articulates, for each targeted micro-watershed, the functions

[24] See Annex 9.

and responsibilities of each government institution in accordance with its respective authority. Each entity must learn to carry out its functions while maintaining a sense of opportunity with respect to the actions performed by other institutions or levels of government, so that there is consistency and an enhanced impact of each and every action taken.

Traditionally, government institutions have worked in isolation, each assuming a topic and approaching problems with a partial focus. The intention is to achieve an integral approach. For the relevant institutions to work in an articulated manner, each one within its scope of authority, as mandated by the National Environment and Climate Change Strategy, the programme will support the integration of inter-institutional harmonization platforms in the municipalities of El Sauce, Achuapa and Villanueva.

The purpose of inter-institutional harmonization in these municipalities will be to optimize the coordination and benefits of the activities in the targeted micro-watersheds performed by each of the national government institutions, the municipal government, cooperatives, farmer associations and NGOs that are active in the area. They will identify the problems as well as seek integral solutions.

Once the micro-watershed committees are created, the articulation between these and the municipal harmonization platforms will be undertaken with the purpose of integrating a watershed committee of the Villanueva River Sub-Watershed, thus contributing to the creation of the watershed body for the Estero Real River Watershed and to the generation of the watershed management tools called for in the General Law of National Waters.

The goal will be to propose a sub-watershed management plan during the last year of the programme at the latest. Based on the experience in preparing micro-watershed plans, the sub-watershed plan should include proposals for normative instruments to build climate change resilience and for the operation of the Villanueva River sub-watershed committee. Its focus will be on water use and protection, soil conservation and enrichment, as well as territorial organization, reflecting the current reality, a shared vision of what "should be", and a transition plan within a timeframe established by the communities, municipalities, cooperatives and professional organizations, NGOs, and the pertinent central government institutions. The proposal for the operational organization of the Villanueva River Sub-Watershed Committee, will aim at ensuring that this body is capable of reviewing, adopting and monitoring the implementation of the sub-watershed plan.

It should be noted that the establishment of a sub-watershed committee will be a key output, significantly augmenting the programme's benefits by providing a strategy to extend in-depth agro-ecological transformation of farm practices to all the other micro-watersheds in the Villanueva River basin. Data from the 2005 census[25] indicates that this will expand the number of rural families benefiting from the programme from 1,005 to 7,120, with a total population of over 33,000.

One of the most important functions of the sub-watershed committee will be to generate a widespread practical educational process through exchange among similar groups. This will allow stakeholders to better understand the particular geo-bio-physical nature of the micro-

[25] These numbers include 85% of the population and rural households counted in El Sauce in 2005, 80% of those in Achuapa, 40% of those in Villanueva, and 30% of those in Somotillo.

watershed where they live and/or act and will help them to plan and monitor the effects of investments in water collection and use, new production practices and other actions included in their co-management plans.

Although exchanges among stakeholders in micro-watersheds in other parts of Nicaragua and Central America may take place, the immediate scope of exchange will be within the Villanueva River Sub-Watershed and, in second place, the other sub-watersheds in the Estero Real River Watershed (Watershed 60). Watershed 60 is the scenario of complex bio-hydrological interactions and very diverse economic activities. Creation of a watershed organization for Watershed 60 will be a complex process that will benefit from the exchange experience among micro-watersheds in the upper Villanueva River Sub-Watershed.

c. Climate change considerations in municipal plans throughout the Watershed (output 3.4)

The programme will also endeavor to ensure that all nine of the municipalities which have a significant portion of their territory within the Estero Real River Watershed participate in the implementation of the National Environment and Climate Change Strategy. To this end, the programme team, in coordination with staff in the Climate Change Directorate in MARENA will identify appropriate climate change adaptation measures for incorporation into municipal land use and water use plans, as well as municipal investment plans. Workshops will be held for municipal officials and staff to assist in the incorporation of these measures in these municipal plans and related normative instruments.

Component 4 – Ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality.

a. Hydrological study (output 4.1)

At the beginning of the programme MARENA will organize the relevant geo-bio-physical and weather data available for the Villanueva River Sub-watershed. This data will be complemented by a study of the hydrological dynamics of the Sub-watershed to identify the causes of the flooding that has occurred in the lower watershed since Hurricane Mitch in 1998.

b. Participatory monitoring (output 4.2)

With support from INETER, MAGFOR, MINSA and INTA training will be provided for the agro-ecology students assigned to each micro-watershed and interested members of the farm families so that they can collect geo-referenced local information about current land use, surface water flows, water quality and soil conditions. In addition to being used in preparing the farm transformation plans (see Component 2, pp.13-15 above), this information will be combined with the relevant data organized by MARENA and the results of the hydrological study of the sub-watershed to provide a detailed characterization of the baseline conditions and the relation between the upper and lower parts of the Villanueva River Sub-watershed.

Data collection training will be repeated each year and interested members of local farm families will be encouraged to learn how to monitor not only their crops and water facilities, but also changes in water flows, soil conditions, erosion rates, and other variables. The goal is that climate change considerations become a part of the communities' ongoing decision-making processes.

c. Electronic information posts and SINIA (output 4.3)

An electronic information post will be installed in each targeted micro-watershed, with a computer technician capable of producing digitalized maps. Each post will maintain interactive communication with the regional node of the National Environmental Information System of Nicaragua (SINIA) located in the Departmental Delegation of MARENA-Leon, and will receive the meteorological information that MARENA obtains from INETER and NOAA. The post will also operate as a programme office serving the micro-watershed co-management body.

Local information, including geo-referenced information used for the farm plans will be digitized and converted into maps of current and projected use of the land in the micro-watershed, and of water sources and systems. These maps, in addition to serving as work documents for farm families, the CAPS, irrigators' associations and other organizations in the micro-watershed, will constitute the main monitoring tool for components 1 and 2 of the programme. It is expected that the precise digitalized monitoring of land use and water presence will become a tool for adaptive management by the micro-watershed committee and that it will be useful and operational for a much longer period than the four years of the programme.

The SINIA work team in the regional node and the staff of the information posts in the eight micro-watersheds will also collaborate with the other early warning systems in the northern area of Leon and Chinandega. With support from MARENA's Climate Change Directorate, the SINIA team will incorporate indicators of variability and climate change in its communications with other national government institutions and in the reports, studies, diagnoses and plans prepared in the other programme components. Since information from the municipal level is transferred to the regional node, the programme's local information system will constitute a new knowledge management tool which will strengthen SINIA's capacity to incorporate data relevant to climate change adaptation to the information it provides at the national level.

Through SINIA, the programme team and other collaborators in the micro-watershed committees, municipal inter-institutional harmonization bodies and the eventual Villanueva River Sub-Watershed Committee, as well as each participating farm family, will have the opportunity to communicate their experience and make socio-environmental contributions to the preparation of government strategies, policies, plans and programs at the municipal, departmental and national levels.

A. Describe how the programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities.

Agricultural practices in the Estero Real River Watershed, where more than 46% of the population is classified as living in extreme poverty, have subverted the adaptability of the production landscape. Although efforts have progressed in promoting more sustainable land management approaches through a series of programmes, the vision of agricultural producers is focused on immediate subsistence and short-term earnings without understanding current risks in weather variability and the threats posed by long-term climate change. Water stress is constant during the dry season and drought periods, related to the recurring El Niño-La Niña (ENOS) events which affect agricultural production and food security. Significant levels of famine characterized the droughts in 1972, 1977, 1991, 1997 and 2003. Surface water

availability is uncertain due to high variability in the region and there are indications that underground water is being exploited in an unsustainable manner. Extraction of underground water resources does not take into account recharge rates; mycorrhizal fungus loss, deforestation, and loose or highly compacted soils limit underground water infiltration. During the wet season, torrential downpours cause recurrent flooding and increased runoffs that progressively wash away the remaining soils.

The social, economic and environmental benefits that the programme will provide for the communities in the Estero Real Watershed, particularly in the Villanueva River Sub-Watershed, are intertwined. These communities are already being decimated by high levels of emigration that leave an increasingly vulnerable population at home. In a region where a little over a decade ago two annual harvests were traditionally harvested, now—due to climate change trends—only one harvest is feasible. This single harvest increasingly tends to have lower yields due to erratic and insufficient rainfall and, in some areas and years, has failed completely. If farm families can demonstrate that at least one harvest per year is certain, their access to credit will rise, overcoming a critical economic barrier.

The economic benefits derive, in the first place, from investments in infrastructure to collect water in order to respond to a series of demands (human and animal consumption, irrigation). Despite the existence of numerous springs, streams and semi-permanent or permanent rivers that could be exploited for drinking water or for small scale irrigation, very few investments have been made in the required infrastructure – most of them in drinking water systems.

Construction of small structures for collection, use and infiltration of rain and ground waters and of two irrigation systems will guarantee at least one full harvest per year for farm families in eight micro-watersheds in the upper part of the watershed. These investments will expand the communities' capacity to respond to water stress and drought, not only improving collective wellbeing, but also raising their potential for subsistence in the face of the reduced rainfall, the intensity of rainy periods and events, and the increased temperatures foreseen in long-term climate change scenarios.

To maximize the economic and environmental benefits of the investments, the selection, construction and implementation of new water structures requires a planning process at the farm and micro-watershed levels. Through agro-ecological farm transformation plans, farm families will articulate their production activities with new water sources. During preparation of these plans, each family will receive a menu of forestry, agro-forestry and silvopastoral production practices. Agro-ecology student teams, guided by the programme's technical specialists and agriculture agency staff will accompany farm families on visits to farms in the area where many of the practices are underway, thanks to the MST project and others.

The preparatory studies undertaken by the Millennium Challenge Account for the irrigation systems in Las Mercedes and Salale concluded that the investments were feasible because of the following internal rates of return[26]:

[26] GFA Consulting Group. Watershed Management Action Plan for Land Use and Integral Use of Prioritized Sub-Watersheds in the Departments of León and Chinandega. MCA-N # QCBS 2006-5. Final Report . Submitted to the Millennium Challenge Account-Nicaragua. November 5, 2007. Page 10.

Investment	Financial IRR	Economic IRR
Irrigation System and Soil and Water Conservation, Las Mercedes	13%	19%
Irrigation System and Soil and Water Conservation, Salale	20%	25%

The investments in rainwater collection and storage are not expected to provide the same benefits as the year-round irrigation systems. Together with the investments in agro-ecological practices, however, they are expected to enable the other 920 farm families in the target micro-watersheds to obtain, at a minimum, an increase in yields equivalent to a quarter hectare of vegetables and at least one annual good harvest from one hectare of corn, thereby ensuring their basic food security at a subsistence level.

Two case studies of producers supported by the current MST project on which the proposed agro-ecological menu is based show very positive economic benefits. In one case[27] agro-forestry practices increased corn yields from 322 kilos per hectare to 774 in the first year. By the third year, the producer studied was harvesting yields of 1,934 kilos per hectare. In the second case[28], a rancher who introduced silvo-pastoral practices on 20 hectares with an investment of US$7,905 spread over three years, saw his annual operating costs increase from US$3,494 to US$4,792. However, his gross income increased from US$4,600 to US$5,800 in the second year and US$13,580 in the third. Consequently, his net income of $8,788 in the third year was greater than his entire investment of US$7,905.

In both these cases, the farms were medium sized and the areas converted to agro-ecological practices were considerably greater than those that will benefit from the investments made by the proposed programme on each family farm. Nevertheless, preliminary results from a study[29] currently underway in the proposed programme area suggest that the examples of these case studies are indicative. With the assumption that the programme will be successful in inducing the practices, capacities and organizational structures required for ongoing adaptive farm and micro-watershed management, it can be expected that agro-ecological practices will be progressively extended to cover whole farms, thereby restoring soils, increasing yields, diversifying production, and enabling a significant portion of the families to achieve important new cash income.

The social benefits of the programme are difficult to estimate numerically. After years of impotence while viewing the progressive erosion of their soils and their manner of living, families will experience a process of learning about new options, of selecting some of them and planning their adoption, as well as planning land use to maximize water collection benefits. The anticipated effect of this social benefit was well expressed in the words of a farmer from Salale: *With the preparation of this programme, I see hope returning to this community; my grandchildren will have new harvests, new opportunities, right here. They will no longer be compelled to emigrate.*

[27] *Case Study 260109. Hipólito Martínez*. MST MARENA-UNDP. 2009.
[28] *Case Study. Luis Urrutia. Economic and Environmental Analysis of a Wooded Slope Silvopastoral System*. MST MARENA-UNDP. 2009.
[29] Economic and Environmental Valuation of Adaptive Production Systems. MST MARENA-UNDP. (Forthcoming)

The environmental benefit will begin with the water collection works that will increase infiltration and recharge the aquifers. Additional benefits will come from the introduction of agro-forestry and silvopastoral practices on farms, where vegetative cover and reduced use of agro-chemicals will conserve existing soils and begin recovery of their biological health and fertility. During the second half of the programme, environmental benefits will be consolidated when the cumulative effect of individual changes in land use on farms is complemented by the effects of communal protection of water recharge areas, and a collective vision of the future is expressed in micro-watershed plans guided and monitored by local committees.

In addition, it is expected that collaboration among participating committees and inter-institutional harmonization platforms in the three municipalities will allow the economic, social and environmental benefits in the highly vulnerable communities of the eight targeted micro-watersheds to have an impact throughout the Villanueva River Sub-Watershed and to exert influence on the governing structures of the Estero Real River Watershed.

The potential cumulative economic benefit is very significant, especially through prevention of the costs of landslides, and reduction of the costs of accumulated soil sediments in the lower part of the Villanueva River Sub-watershed. Annual flooding there causes millions of dollars of damage each year through crop and cattle loss, roadbed erosion, emergency shelters, and housing damage. The study of the hydrological dynamics in the sub-watershed is expected to identify the works needed to repair the effects caused by Hurricane Mitch and the erosion of the subsequent 12 years. Once these works have been completed, avoidance of recurrent flooding will be determined by the programme's success in demonstrating that the intensive adaptation scheme composed of water retention and agro-ecological transformation of farm practices in micro-watersheds makes soil conservation in the upper watershed both feasible and profitable.

B. Describe or provide an analysis of the cost-effectiveness of the proposed programme.

Two alternative strategies were considered for addressing the underlying problem. The first was to concentrate on national policy development for climate change adaptation. This option was discarded because Nicaragua already has a national climate change strategy that addresses adaptation, a new water law, and a governmental commitment to introduce agro-ecological principles into all agricultural policies. What the country needs is not more policy initiatives, but rather effective implementation of the policies that exist or are in preparation.

As discussed in sections B, C and D of Part I of this document (see pp. 2-4 above), important lessons learned in regard to rural development, environment management, water management, and watershed management have only sporadically been applied by the respective national institutions with authority in these areas. Much less frequently have these lessons been effectively harmonized and applied together in specific sub and micro-watersheds.

Consequently, the decision was made to use the country's first specific climate change adaptation programme to focus on integrated environmental and agricultural policy implementation. The water retention investments of Component 1 are made essential by ever more serious climate changes that bring the threat of droughts and famine. To be effective in soil retention and recovery at the farm level, these investments must be accompanied in component 2 by agro-ecological practices. Agro-ecological transformation, in turn, cannot be

left only at the farm level: to achieve the expected environmental effects of ecosystem recovery, it has to be a generalized process at the micro-watershed level, planned by a community organized in component 3. In this way, the crucial additionality of vulnerability to climate change in water stressed rural areas acts as a catalyst that integrates verified agro-ecological and watershed management practices in one coordinated process.

The potential benefit of this approach is considerable. If effective, it will serve as a demonstration of how to apply the National Environmental and Climate Change Strategy, and it will also stimulate the introduction of climate change adaptation measures as key elements in national efforts to achieve effective implementation of agricultural policies, on the one hand, and of water and watershed management policies on the other. Catalyzing the energies of these large sectors is likely to be much more effective in mainstreaming climate change adaptation than a focus on strengthening national policy for climate change adaptation.

Within the framework of a focus on policy implementation, an alternative strategy considered was a much wider geographic scope. A wide geographic scope is often used in rural development programmes with an explicit environmental emphasis[30]. The argument in favor of a wide geographic scope is that a programme can support the development of model farms in many areas and thereby stimulate the replication of the practices they demonstrate by a large number of farm families.

There are two limitations to such an approach. The first is that individual farm families, even those who are enthusiastic about the success of their innovations, have difficulty sustaining the changes they make on their farms when surrounded by communities that continue using "traditional" chemical-intensive soil-depleting agriculture practices. Social reinforcement in local communities is an important factor for sustainability, and it is usually lacking in projects and programmes with a broad geographic scope.

A second consideration is especially important for a programme that has climate change adaptation as its primary goal. While agro-ecological practices may significantly improve soil conditions on an individual farm they are unlikely to have a measurable effect on water retention in an aquifer, on surface water flows and on landslide resistance in an area with steep slopes unless they are introduced on all or most of the farms in the neighborhood.

The proposed programme will be implemented within the context of the Water Law, which calls for a comprehensive watershed management approach. To date and to a great extent, considerations about climate change have been absent from production processes and also from regulatory and development approaches, a situation aggravated by the fact that decisions at all levels have been made with a short-term horizon, both in terms of space and timeframe. There is a limited understanding of the interdependencies in the watershed and also of the differentiated impacts and socioeconomic interests that could worsen due to weather stress, which will require responses focused on responding to collateral effects, opportunity costs and common problems that build on eco-systemic synergies.

[30] This is the case, for example, with both the Integrated Watershed Water and Sanitation Programme (PIMCHAS) and the Sustainable Soil Management Project (MST) which both made important contributions to the menu of agro-ecological and conservation practices included in the design of this project. It is also the case of the new Environmental Programme for Management of Disaster Risks and Climate Change recently approved by the Nordic Development Fund and the Inter-American Development Bank.

The strategy of concentrated intervention in a small number of micro-watersheds was chosen because the micro-watershed is the space where the strongest interactions between use and management of natural resources take place. No other scope of action that could be considered (municipality, community, farm, etc.), maintains this relation in such a focused and tangible manner. The tightly knit web of social relations that is usually found within the micro-watershed provides a starting point for stakeholder organization and the cultural change process needed if farm families are to assume broadened geographic and temporal perspectives in their decision-making. Ongoing adaptation to climate change requires this change in perspective; for the required cultural change to take place, individual and collective actions and their combined impacts on water flows and soil conservation must be seen as an integrated whole.

The programme will incorporate responsive measures to climate change to the debate at all levels: the stakeholders in the Villanueva River Sub-Watershed will articulate development/investment plans and municipal adaptation strategies, which in turn will provide usable examples for practical implementation and application of the National Water Law at a national level. Because of this feedback the programme will provide an experience of interest for Nicaragua, validating adaptive co-management methodologies for watersheds that raise local capacities for long term response to climate change impacts.

Since the water and agricultural sectors have been identified as the most vulnerable to climate change, the programme seeks to promote comprehensive socio-agro-environmental responses. From the production perspective, the intervention strategy not only addresses water supply but also the matter of demand. In addition to applying technologies and approaches focused on harvests and water storage, practices in the use of soils and water will seek to rationalize the water demand and in turn contribute to increasing water supply through approaches that include protection of underground water recharge areas, and activities to improve water infiltration in the production landscape. The programme's intervention strategy is, therefore, very comprehensive, addressing the requirements for effective responses to climate change at the local and the sub-watershed level on a range of critical fronts.

The concentration of programme resources in eight micro-watersheds located within the much larger area where MARENA is finalizing the Sustainable Land Management Project (MST) will capitalize the demonstration value of the individual farms supported by the MST while applying lessons learned in other participatory watershed management projects/programmes that demonstrate the importance of community organization for long-term sustainable investments. Additionally, by supporting and fostering the operation of the inter-institutional harmonization platforms in three municipalities, facilitating the participation of government and non-governmental institutions in their respective areas of competence, the programme will avoid the cost of duplicating functions inherent to programmes that replace (rather than reinforce) the functions of the national institutions that are present.

C. Describe how the programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

a. National Policies, Strategies, Laws and Regulations

The Government for National Reconciliation and Unity promotes a model called "Citizen Power" that seeks the participation and involvement of stakeholders at all levels in ensuring healthy environmental management, the struggle against poverty, and solid economic management, including reduction of vulnerability to climate change and recent natural disasters. The ***National Human Development Plan (PNDH)*** and other development plans for specific sectors prioritize water and agriculture as the sectors most vulnerable to climate change. The agricultural sector, in addition to being the main source of food security, provides employment and a livelihood for more than 60% of the population. The ***National Plan against Drought*** also underscores the need to reduce vulnerability to climate change.

On June 17th, 2009, the National Assembly approved **Resolution** **A.N. No. 003-2009** ***Climate Change and its Adaptability in Nicaragua*** which states:

> *Due to the nature and potential impacts that climate change may cause in Nicaragua, it is of the utmost importance to articulate preventive actions, in the preparation and implementation of National Adaptation Strategies and Plans to increase the capacity for adaptation of the human systems most vulnerable to extreme events, climate variability and climate change, understanding that adaptation is not an option, but rather an inescapable reality.*

Subparagraph viii *(The Environment, Production, Conservation, Development and Life)*, in the list of principles of the ***Agricultural, Livestock and Forestry Strategy*** of the ***PNDH***, states:

> *Sustainable management of land, water and forests is promoted by improving practices and instruments to face climate change, agricultural vulnerability to nature and the harmonization of life, placing human beings as part of a complex environmental and life system.*

Another advance is a series of new government policies related to climate change and agro-ecological practices. Inter-institutional harmonization entities at the municipal level will be able to use these policies to guide the actions of its members in rural communities.

The National Environmental and Climate Change Strategy and the ***2010-2015 Action Plan*** were approved by the executive branch in April 2010. This strategy seeks to:

> *guarantee the participation of organized people and government institutions in developing actions to conserve and preserve our natural resources as the practical expression of the principles of the Universal Declaration of the Common Good of the Earth and Humanity that call for us to understand the Earth as alive and a subject of dignity.*

It also affirms that:

> *environmental education is indispensable…in order to rescue the values, knowledge, and attitudes of love, care and protection of Mother Earth, affirming that this education is the basis for ensuring that the population carries out actions to defend and protect natural resources by making good use of agricultural soils through land*

use planning, water conservation, recovery, retention and harvesting, that contribute to mitigation, adaptation and risk management in the face of climate change…

To comply with this proposal, the strategy calls for *a grand alliance among the National Government, Municipal and Regional Governments, Private Enterprise, farmers, workers and social and environmental movements.*

Following instructions from the Presidency of the Republic, the Ministry of Agriculture (MAGFOR) is developing a new ***Policy for Development of Agro-Ecological Production,*** which—in its current draft undergoing consultation—has as its objective:

to contribute to the transformation of the current production systems into sustainable systems, that based on ecological principles improve the living conditions of producers and consumers and guarantee healthy quality products to society, recovering and improving the capacities of ecosystems in the short, medium and long term.

Simultaneously, MAGFOR is revising all existing national agricultural policies to bring them in line with this new policy. The mission statement proposed in the current draft of the new ***Agricultural Technology Policy***, for example, calls for the agricultural technology system

…to induce changes in the agrarian system, reinforcing it with new production practices that incorporate ecological and environmental concepts for ecosystem and agro-ecosystem management in a context of climate change and variability.

These approved and draft documents demonstrate political will and an express mandate on the part of the National Government to achieve the articulation that must exist among the different institutions at different levels of authority and government in order to face the situations created by climatic variability. All these policies point toward the need to implement the lessons learned in participatory watershed management.

There are also three legal instruments that guide the manner in which the programme will approach its work in relation to water resources. ***Law 620, National Water Law,*** approved in 2007, calls for the development of plans and instruments to advance in an integrated approach to water resources. It sets forth the legal framework for sustainable water use and exploitation, as well as the relations among government institutions, private parties, and citizen organizations in managing the resource. The Law defines water as *a finite and vulnerable resource essential for existence and development, constituting a strategic natural resource for the country; therefore, its access is a right associated to human life and health that must be guaranteed by the State for the Nicaraguan people.* In particular, the Law assigns high importance to management at the level of the watershed, the sub-watershed and the micro-watershed as a platform to coordinate and articulate a broad range of interests and differentiated impacts.

During the month of May 2010, the National Assembly approved ***Law 722, Special Law for Drinking Water and Sanitation Committees***, which provides legal grounds for over 5000 existing drinking water and sanitation committees (CAPS) in rural areas, which are the strongest

and most organized expression of the interest of local communities in water issues. Among the CAPS' functions, this Law states that they are to *monitor and protect sources of supply…, avoid their contamination and help to protect the micro-watersheds of the water supply sources* (Article 17 h). It confirms the support of national government entities by establishing that:

> *…the Ministry of the Environment and Natural Resources, the Ministry of Health, the National Forestry Institute, the Nicaraguan Development Institute, and the Social Emergency Investment Fund, in coordination with the respective municipalities, will support the CAPS with training in administration, sustainability, service operations, water quality control, care of the environment and especially the protection and conservation of water sources.* (Article 29).

In August 2010, together with the Minister of the Environment and Natural Resources, the President of the Republic signed the new ***Regulations to Law No. 620, National Water Law, Decree 44-2010.*** These regulations recognize the Drinking Water Committees and the Drinking Water and Sanitation Committees (CAPS) – as well as the Watershed Organizations and the Watershed Committees (both pending creation) – as institutions directly linked to water resources, and states that:

> *The Watershed Organizations will promote…the creation of as many Sub-Watershed and/or Micro-Watershed Committees as are needed in the watershed…with the purpose of guaranteeing adequate citizen participation.* **(**Article 36- Decree 44-2010)

In addition, the Regulations also establish the responsibilities of the government bodies that will participate in the programme activities in the Villanueva River micro-watersheds and sub-watershed, stating:

> *In coordination with INTA, MAFOR will promote research and technological transferences for use of biological and natural products in agriculture, among other clean production practices in order to prevent soil and water quality contamination. Efficiency and the use of environmental technologies will be part of the criteria for granting economic aid…* (Article 72, Decree 44-2010), and
>
> *MARENA will regulate and govern through technical criteria the definition, mechanisms and flow management of the minimum flows to maintain ecological balance and sustain biodiversity in the watersheds.* (Article 84, Decree 44-2010)

The programme design is consistent with these guidelines by attributing to MAGFOR and INTA—this last supported by universities with which it has agreements—the responsibility for guiding the activities of Component 2 and by assigning MARENA direct responsibility for the monitoring process and assessment of impacts, in addition to its responsibilities as the executing entity for the programme as a whole.

b. United Nations Development Assistance Framework

In line with Millennium Development Goal 7, Cooperation Area 4 of the ***United Nations Development Assistance Framework (UNDAF)*** for Nicaragua is *Protection of the Environment*

and Risk Management for sustainable human development. The direct effect expected in the UNDP program in this area is defined as *Strengthened capacities of public institutions, communities, civil society and the private sector to promote, formulate and implement policies, plans and programs that reduce the environmental vulnerability of the population and promote sustainable human development.*

The Framework also identifies integration of *the climate change mitigation and adaptation variable in the pertinent national strategies, programs and plans* as a specific product expected in the country program.

This programme will contribute to these effects, most particularly in the difficult area of improving implementation of pertinent national policies for climate change adaptation, reduction of environmental vulnerability and sustainable human development.

D. Describe how the programme meets relevant national technical standards, where applicable.

The programme will guarantee respect and consistent application of national standards for infrastructure construction.

The two major works are the irrigation systems designed for the Las Mercedes and Salale micro-watersheds. Due to the size of these works, and in accordance with Article 7 of *Decree No. 76-2006 Environmental Assessment System* and Article 31 of *Law No. 647, Reforms and Additions to the Law No. 217, General Law of the Environment and Natural Resources Act,* the programmes are not considered to be in Category I, II or III. They are identified as works that may cause *Low Potential Environmental Impacts,* and therefore they are *not subject to an Environmental Impact Study*. The only requirement is submission of environmental permit requests to the corresponding municipal authority.

As part of the feasibility studies for these two systems, the Millennium Challenge Account Foundation carried out this procedure and the Municipal Government of El Sauce granted the respective environmental permits[31]. Once the programme begins, the permits will be updated.

Aside from the municipal environmental permits, there are no other national standards and safeguards to which the anticipated programme works are subject. Nonetheless given the requirements of the Millennium Challenge Corporation, an environmental management plan was established to address any potential negative impacts of the reservoir and connected constructions. The environmental management plan was presented to municipal authorities as a basis for the issuance of the corresponding environmental permit. The environmental management plan is detailed in the feasibility study and the construction firm must comply with it, under the supervision of both the Municipality and the Departmental Delegation of MARENA. The programme will specifically enhance the capacities of these entities to follow up the construction and compliance with the specified environmental standards and remedial actions.

In addition to this, all UNDP supported donor funded programmes are required to follow the mandatory requirements outlined in the UNDP Programme and Operational Policies and

[31] See Annex 6

Procedures (UNDP POPP). This includes the requirement that all UNDP development solutions must always reflect local circumstances and aspirations and draw upon national actors and capabilities.

Moreover, all UNDP supported donor funded programmes are appraised before approval. During appraisal, appropriate UNDP representatives and stakeholders ensure that the programme has been designed with a clear focus on agreed results. The appraisal is conducted through the formal meeting of the Programme Appraisal Committee (PAC) established by the UNDP Resident Representative. The PAC representatives are independent in that they should not have participated in the formulation of the programme and should have no vested interest in the approval of the programme. Appraisal is based on a detailed quality programming checklist which ensures, amongst other issues, that necessary safeguards have been addressed and incorporated into the programme design.

E. Describe if there is duplication of programme with other funding sources, if any.

Various noteworthy initiatives are underway in the programme area. Two of these are particularly relevant: the project *Sustainable Land Management (MST)* funded by GEF-UNDP and the *Comprehensive Watershed Management Project, Water and Sanitation (PIMCHAS)* funded by Canada, Denmark and Spain. Both projects are executed by MARENA.

The two ongoing programmes constitute a development baseline upon which the proposed programme would build. Although certainly not a main objective of these interventions, insofar as SLM approaches improve and maintain ecosystem services and functions, they contribute to climate change adaptation goals. However, these two programmes do not contemplate specific activities that will have as a primary objective the reduction of risks posed by increasing climatic variability and long-term climatic trends which indicate, *inter alia*, longer drought periods and more erratic rainfall during the wet season - which put even the single annual crop that is today feasible (the second crop is no longer a viable option in the upper and mid watershed) at risk.

Nonetheless, the contributions of these programmes to the development baseline go beyond their work on SLM. The work undertaken in terms of extension and farmer outreach support services has strengthened the capacity of MARENA (which executes both programmes and would execute the proposed initiative) to deliver on the ground training and capacity building, and to promote changes in land use practices (agricultural, livestock and agroforestry related). These efforts will now help to ensure that the activities contemplated under Component 2 can be efficiently and effectively developed and put into practice with a range of resource users within the targeted watershed.

Equally important, these programmes have laid the ground for improved community organizational arrangements within their system boundaries. Efforts have been ongoing with the municipal planning, environmental and water and sanitation units, as well as with the departmental MARENA office. Although there is only a marginal geographic overlap between the proposed programme and the two ongoing interventions (only 3 of the 26 municipalities within the latter two would participate in the proposed initiative), this would enable the proposed programme to build upon the successful efforts in these three municipalities to strengthen municipal capacities for sustainable natural resource management. Nonetheless, neither one of the two ongoing programmes have sought to mainstream CC considerations into

efforts at municipal level, neither in terms of capacity building nor of development of land-use plans. Therefore, as noted above, these programmes constitute a foundation upon which the proposed intervention would build. In addition to this, through these two programmes the capacity of MARENA to execute projects/programmes has definitely been strengthened.

The PIMCHAS project, which will conclude most of its components in 2011 and close down in 2012, supports activities in the Rio Negro Watershed (Watershed 58), adjacent to the sub-watershed of the Villanueva River in Watershed 60. PIMCHAS is strengthening the approach to governance in Watershed 58 by increasing the capacity of municipal authorities to address environmental issues and it has also established a fund for small and medium farmers. These activities are particularly relevant in the municipality of Achuapa since its territory is largely within the Watershed 58.

Additionally, as part of a short-term work plan agreed upon with the municipal governments of Achuapa and El Sauce, during the last quarter of 2010 and throughout 2011 PIMCHAS will support a number of activities to strengthen the drinking water and domestic sanitation systems in four micro-watersheds. One of these is Salale, which will be one of the eight targeted micro-watersheds in this project. PIMCHAS's principal activities will include demarcation of the area around the source of the drinking water systems and capacity development for the leaders of the CAPS.

These activities will be complementary with those of the proposed programme. PIMCHAS' experience in other watersheds was taken into account in this programme design; the support for inter-institutional coordination entities at the municipal level in Somotillo and Achuapa will increase their ability to act in both Watersheds 58 and 60; improvements in the drinking water system and its local administration in Salale will contribute to the overall organization in this micro-watershed and help local residents prepare for the construction of the new irrigation system in late 2011.

The MST project, while will conclude in 2011, is promoting environmentally sustainable farm production systems in twelve municipalities, working closely with municipal environmental management units it has strengthened. In the design of Programme Component 2, the experience of the MST has been used advantageously. This programme will incorporate the production practices implemented by beneficiaries of the MST into the menu of validated agro-ecological practices. To this end materials printed by MST will continue to be used and the farms of MST beneficiaries will serve as living exhibits for farm families. By concentrating efforts in the geographic space of eight micro-watersheds, the programme will move forward from the MST's work, seeking a critical mass of changes in farm practices that generates measurable environmental impacts, particularly on the conservation of soils and groundwater recharge.

Other programmes run by the Nicaraguan Institute of Agricultural Technology (INTA), the National Forestry Institute (INAFOR) and the Ministry of Agriculture, Livestock and Forestry (MAGFOR) seek to increase food security in the programme area. These projects are fully complementary to the proposed programme and the participation of agricultural sector institutions in micro-watersheds and in inter-institutional harmonization bodies at the municipal level will ensure that lessons learned in one programme can be communicated fluently to the executing agencies of others.

The Estero Real estuary at the bottom of Watershed 60 is a large protected area given high priority in the UNDP-GEF financed project to strengthen MARENA's National System of Protected Areas (SINAP). Specific projects focus on the lower watershed, both addressing tri-national cooperation in the Gulf of Fonseca and—with support from the AECID and Spanish Friends of the Earth—developing CAPS and promoting biological connectivity between the protected areas in the Department of Chinandega. MARENA will ensure fluid communication between these initiatives and the proposed programme, especially when the National Water Authority (ANA) initiates preparation of the overall Watershed Organization. The hydrological study of the Villanueva River basin and the experience developed by the programme in implementation of the National Environmental and Climate Change Strategy will be valuable contributions for the future work of the Estero Real River Watershed Organization, once it is established by ANA.

F. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

The presence of a team of agro-ecology and anthropology students, guided by the programme team and professional staff from relevant sector agencies, will ensure detailed study of the production, social and organizational processes in each micro-watershed. Through Component 4 (see pp. 21-22) the experience will be documented and reflected in digitalized maps that track changes in land use and facilitate the analysis of relations between them and water flows. The electronic information posts set up in each micro-watershed will strengthen the regional node of the National Environmental Information System of Nicaragua (SINIA) and provide MARENA with the capacity to register relevant data, extract, analyze and organize the lessons derived from the implementation of all programme components.

The MARENA Directorate for Climate Change will exercise the national direction of the programme and will ensure that relevant lessons for climate change adaptation help increase adaptive capacities nationally and are used as a basis for future responsive measures.

It is expected that the intensive experience of planning, action, analysis and monitoring of results in the eight micro-watersheds will be a learning process not only for local families and the students who accompany them, but also for the professionals in government and non-governmental institutions who participate in their respective agency roles. In this way, the analysis of lessons learned by MARENA's programme management team and their dissemination through SINIA, will be accompanied by the professional development of staff in the national institutions that have a mandate to implement the upcoming national agro-environmental policy and the *National Environmental and Climate Change Strategy*.

Additionally, through the implementing agency, liaisons will be established with the UNDP-GEF Adaptation Learning Mechanism to ensure that the lessons of this programme reach a wider audience in Central America and beyond, including other donors and agencies involved in similar initiatives in other countries.

G. Describe the consultative process, including the list of stakeholders consulted, undertaken during programme preparation.

Annex 7 presents a list of stakeholders consulted during programme preparation. The follow table summarizes the matters addressed in the meetings with diverse institutions, organizations and officials.

Entity or person(s) consulted (s)	Issues Addressed	Components discussed
MARENA Planning Directorate Climate Change Directorate	Programme scope; organization criteria; official counterpart of the programme formulation process. Review of draft ProDoc.	1-2-3-4.
Territorial Delegation MARENA-León MST Programme SINIA Regional Node	Technical information about the programme area; MST's experience; organization of the consultation process with local stakeholders.	1-2-3-4.
MAGFOR General Policy Director General of Policy Director of Technological Policies	Programme scope; MAGFOR role in Component 2; new agro-ecological policy; general policy review; coordination of PRO-RURAL actors.	1-2-3-4. Especially 2.
Specialist in Territorial Organization		
Social Emergency Investment Fund (FISE) Operations Division	Technical requirements and criteria for small water works	1
Ministry of Transportation and Infrastructure Environmental Management Coordination Construction Control and Registry		
INTA Coordinator of the Sustainable Agriculture Sub-Program	Component 2. Agricultural and Livestock practices developed by INTA.	2-3-4 Especially 2.
Outreach Worker, El Sauce Municipality		
Sustainable Agricultural Subprogram Specialist – CEO		
Nicaraguan Institute for Territorial Studies (INETER) Deputy Director General Division of Water Resources	Coordination; willingness to train local stakeholders for gathering water data; Hydrological Study and Map of El Sauce Watershed.	1-2-3-4.
Las Mercedes Community, Municipality of El Sauce	Information of the Irrigators' Association. Levels of articulation of the community around care of water sources. CAPS: 13 years in operation with 80 families.	1-2-3
Salale Community, Municipality of El Sauce	Information about irrigators' associations. Meeting date	1-2
	Presence of 24 farmers. Programme scope.	

	Farmers feel worn out; they have waited for a long time. One of them does not want to grant the right of way but the commitment is that they will all convince him.	
Production Cabinet, El Sauce Mayor, Deputy Mayor, MAGFOR, President of UNAG, Community Leaders, World Vision, COFODEC, Office for Development, others	Programme rationale. Situation in Salale and Las Mercedes. Other possible micro-watersheds. Coordination with the Cabinet.	1-2-3-4
Municipality of El Sauce Mayor & Deputy Mayor Planning Director Head of Environment Unit	Programme scope; Need to establish level of commitment by the municipal government and its articulation with institutions at the national level.	1-2-3-4.
Procurement officer in El Sauce	Capacity of the municipalities to execute the procurement processes for works, goods and services with sufficient juridical security.	1-2
Leader from Petaquilla Community	Need for a programme of this nature in other communities, where the population is convinced that a change must take place but only need support.	1-2
National Agricultural and Stockbreeders Union (UNAG) President, Municipal Chapter, El Sauce	This organization of farmers and stockbreeders, which is one of the largest in the country, is willing to make a commitment with this type of programme and to support each and every one of its actions.	2
Municipality of Achuapa Mayor and Deputy Mayor	Programme scope; Need to establish level of commitment by the municipal government and its articulation with institutions at the national level.	1-2-3-4.
INTA Deputy Director	New agro-ecological guidelines. Watershed approach. Agreements with UNAN León and UNAN Managua. Value of students, particularly of anthropology.	1-2-3-4.
Municipality of Achuapa Head of Infrastructure Unit	Information about 8 existing CAPS in the municipality.	1
Municipality of Achuapa Head of Environment Unit	Existing inter-institutional coordination	1-2-3
Francisco Paz Silva Foundation, Achuapa	They will develop organic practices	2-3

Municipality of Villanueva Mayor	Programme scope; Need to establish level of commitment by the municipal government and its articulation with institutions at the national level. Major environmental problem: annual flooding in the Apacunca sector, forcing many families to emigrate and abandon all of their household goods. Possibility of working in the upper part the Villanueva River basin.	1-2-3-4.
Municipality of Villanueva Head of Environment Unit	Identification of micro-watersheds and communities proposed for interventions by the UNDP programme.	1-2-3.
Municipality of Somotillo Mayor	Causes of annual flooding. Changed courses of Gallo and Negro rivers; sediments in Villanueva River. Impact on Apacunca, and Teocinte Natural Reserve. Human impacts of climate change and variability.	1-2-3-4.
Municipality of Somotillo Head of Environment Unit	Cooperatives in the lower part of the Villanueva River sub-watershed, especially organic growers.	2-4.
Millennium Challenge Account Foundation Deputy Director Transportation Programme Director	Background study of the watersheds. Programmes studied for Watershed 60. Background study proposed to determine the causes of flooding.	1-2-4
Team of Hydrology Engineers	Costs and duration of a hydrological study of flooding causes on the lower Estero Real River Watershed.	4
Municipality of Somotillo Head of Agriculture Unit	Rapprochement with Apacunca leaders. This community has leaders from Villanueva and Somotillo.	4
Visit to Apacunca Community	Families affected by floods can only leave their homes by using water transportation and most families do not have this. Area background. Effects of Villanueva River dredging. Proposal to continue with the dredging.	4
Associations of Municipalities of Northern Leon (AMULEON) and Northern Chinandega (AMUNORCHI); Executive Directors	Programme scope, inter-institutional articulation in the different components.	1-2-3-4.
Institute for Rural Development (IDR), Managua Delegation	Relevance of: - working with departmental production cabinets	2-3

	- use of thesis university students - use of PRORURAL structures - use of a hands-on learning methodology with farmers	
Institute for Social Research and Management (INGES) President of the Board of Directors	Information about the Achuapa Agreements and other information relevant to the programme area.	1-2-3
National Univerisity of Nicaragua, UNAN-Managua. Director of the Anthropology Department	Coordination to assess the methodology to incorporate anthropology students to induce cultural changes in communities.	2-3-4
MAGFOR Policy Workshops	Draft National Agro-ecological Policy. Draft National Agricultural Technology Policy.	2
Regional University Center (CURS) Somotillo	Coordination to assess methodologies to incorporate agro-ecology students to field practices.	2-4
National Institute for Technical Education (INATEC) El Sauce		
PIMCHAS Head of Institutional Development	PIMCHAS's plans in the upper part of the Rio Negro and Estero Real watersheds.	2-3
Friends of the Earth	Intervention in lower Estero Real Watershed	3-4
National Water Authority Executive Director	Programme Scope Relation with ANA	1-2-3-4.

H. Provide justification for funding requested, focusing on the full cost of adaptation reasoning.

Component 1 – Investments in infrastructure for storing and using rain and surface water in eight micro-watersheds in the upper watershed of the Estero Real River.

Baseline (without AF resources)

Government efforts are underway to implement the *National Water Law,* the *National Environmental and Climate Change Strategy*, and the *Special Law for Drinking Water and Sanitation Committees* in the upper part of the Estero Real River watershed. Investments to improve domestic water supply systems are underway or planned in four communities, including one located inside one of the targeted micro-watersheds. Local Drinking Water and Sanitation Committees have been newly recognized by law and they provide an initial organizational base for community–level water management. Municipal Environmental Management Units have been strengthened by MARENA and they are working together with national government agencies responsible for agricultural development to coordinate water management and agricultural development activities. MARENA has plans to introduce climate change considerations into the municipal planning discussions and the National Institute of Agricultural Technology is developing specific climate resilient crop varieties.

Increasingly frequent climate induced water shortages, however, pose a major barrier to the success of these efforts. Lack of water retention and high rates of erosion during the rainy season augment the conditions that lead to increasingly poor yields and frequent crop failure; water stress and crop failure impede access to credit and reinforce fatalistic attitudes toward the future. In these conditions, local farm families find it difficult to make use of available technical support and to organize for communal water management.

Additionality (with AF resources)

Investment in local infrastructure to harvest rainwater and retain part of the surface water available in eight micro-watersheds in the municipalities of Achuapa, El Sauce and Villanueva will increase the water supply available for domestic and productive use during the crop cycle. With sufficient water to ensure at least one annual harvest, farm families will be able to adopt agro-ecological practices and observe their effects in increasing yields and enriching soils. This will reduce the risk of climate-induced water shortages and provide a starting point for development of individual and communal capacities to adapt to climate variability and long-term climate change.

The concentration of water retention investments in micro-watersheds in the upper Villanueva River basin will have a cumulative effect on soil erosion and sedimentation. This will enable sub-watershed planning and investments aimed at curbing flood devastation in the lower watershed.

Government efforts to implement the Water Law, the Climate Change Strategy and agro-ecological policies will be supported by geographically concentrated investment in low-cost infrastructure that has the potential to eliminate a major barrier to the development of capabilities for adaptation to climate change.

Component 2 – Introduction of climate resilient agro-ecological practices to make effective use of available water.

Baseline (without AF resources)

The governmental agencies responsible for rural development have made significant efforts at the national level to promote ownership, harmonization and alignment through the ProRural sector program. On model farms located throughout the proposed programme area, MARENA is working with municipal governments and the ProRural agencies to support agro-forestry and silvo-pastoral land management measures. Many beneficiary farms are demonstrating significantly increased yields. The upcoming *Policy for Development of Agro-Ecological Production* will encourage institutionalization of the extension practices used to achieve these benefits.

To date, agro-forestry and sustainable land management extension methodologies have focused on individual farms. Existing projects promoting agro-ecological practices have not concentrated their operations geographically to generate a critical mass of innovations capable of producing measurable effects on water flows.

Farm families have not yet realized the need to minimize climate change risks in their production processes. Their timeframes are typically short-term concerns related to production

during the next season. Geographic frameworks are limited to the individual farm and do not take into account cumulative effects.

Additionality (with AF resources)

The programme will apply validated methodologies for introducing agro-ecological practices to farm families concentrated in eight micro-watersheds selected because of their importance for collective adaptation to climate change effects in the Villanueva River basin. Making use of existing materials and living demonstrations of model production practices, the programme will capitalize the outputs of programmes financed by UNDP-GEF and bilateral donors.

By providing additional support for recent agreements between the National Institute for Agricultural Technology (INTA) and university agro-ecology departments, the programme will simultaneously stimulate the implementation of new national agro-ecological policies, help institutionalize the results of earlier programmes, and facilitate the acquisition of appropriate knowledge, attitudes and promotional behavior by the extension staff of the national governmental agencies responsible for rural and agricultural development. This innovation will be reinforced by timely input from national agro-ecological producers' associations and guided by agricultural extension staff on the programme team selected because of their experience in application of agro-ecological practices at the micro-watershed level.

By focusing its interventions on farm families that also benefit from the water retention and irrigation system investments included in Component 1, the programme will minimize the risk that, due to drought, new agro-ecological practices fail to improve crop yields. At least 140 hectares will be converted to water-conscious and climate resilient agro-ecological production in each micro-watershed.

By sustaining this geographic focus over a four year period, the programme will also maximize the likelihood of achieving measurable effects in soil conditions and water flows at the micro-watershed level. This will enable farm families to visualize the cumulative effects of new farm practices on water availability and stimulate their willingness to participate in collective activities to manage climate change risks by protecting at least 50 hectares in each micro-watershed in water system recharge areas and riparian zones by means of water-retention chambers, artisanal dikes, natural regeneration and—where needed—reforestation with native species.

The programme will stimulate, organize and support the sustained intervention of teams composed of programme staff, municipal staff, national governmental agency staff, university students, local cooperatives and national agro-ecological producers over a four year period in each micro-watershed. This intervention will be grounded in patient accompaniment of over 1000 farm families in the preparation and implementation of agro-ecological farm transformation plans. Through this intensive sustained effort, the programme will seek to ensure that these farm families continue to use their own newly increased resources and available credit for ongoing implementation of their agro-ecological farm transformation plans once the programme is over, and that they will be accompanied in this endeavor by national and municipal staff who have become fully experienced in promoting and supporting the introduction of water-conscious and climate resilient agro-ecological production practices at the micro-watershed level.

Component 3 – Institutional development and capacity building in micro-watersheds, municipalities, and participating national institutions.

Baseline (without AF resources)

The degree of community organization in the micro-watersheds is relatively strong, with elected leaders, active political parties, CAPS, and religious organizations. Some farm families in each micro-watershed have had training in good agricultural practices with an environmentally conscious approach. Organizational development and technical training, however, coexist with deeply rooted traditional practices and fatalistic attitudes typical of subsistence farmers. The drastic effects of droughts and hurricanes are accepted as inevitable; the area is perceived as poor by nature, and it is considered normal for young people to travel to the capital or other countries in search of opportunities to improve the quality of life for their families.

At the municipal level, agricultural production cabinets function as harmonization bodies that seek to ensure information exchange and varying levels of work plan coordination among the municipal government, agencies of the national government, producers associations, cooperatives, NGOs and any relevant programmes. Climate change adaptation, while recognized as an important issue, has not been incorporated into municipal plans and inter-institutional strategies. In the municipalities of El Sauce and Achuapa, most of the members of the agricultural production cabinets have participated in workshops to prioritize water management issues in the micro-watersheds that compose the upper watersheds of the Villanueva River and the Negro River. During 2011 climate change issues will be addressed in further workshops about watershed management.

The newly created National Water Authority (ANA) has a mandate to create a watershed committee for the Rio Villanueva sub-watershed and a watershed management body for the Estero Real River watershed.

Additionality (with AF resources)

In each community the programme will work with water management bodies (CAPS, irrigators' associations), producers associations (cooperatives, affiliates of sector organizations or national bodies), farm families, umbrella community organizations (citizen power cabinets, others), and other groups present (women's groups, youth groups, churches, others) to identify the appropriate role for each organization and group in the preparation and implementation of micro-watershed management plans. Simultaneously, both through implementation of components 1 and 2, and through an educational process capitalizing on the experience of MARENA's Climate Change Directorate and INETER's General Directorates of Meteorology and Water Resources, the programme will assist local stakeholders in acquiring the information needed to ensure that their micro-watershed management plans are climate resilient and likely to increase water retention, soil conservation and food security. It is expected that within the first eighteen months of the programme the stakeholders in each micro-watershed will have created or selected an organization that functions as the micro-watershed committee.

The programme coordinator and programme outreach workers will become active members of the municipal agricultural production cabinets[32] in El Sauce, Achuapa and Villanueva in order to

[32] And in any other relevant inter-institutional harmonization bodies.

ensure that all participants are kept up to date on programme activities and to facilitate the coordination of governmental and non-governmental agency work-plans in the micro-watersheds located in each municipality.

The programme team will engage in ongoing analysis of the evolving experience in the micro-watersheds, and endeavor to identify the need for normative instruments to help build climate change resilience at the community level. The programme director will invite the municipal cabinets to help draft such instruments and to propose them for adoption by the pertinent authority, be this the National Water Authority, a government ministry or the local municipal council. Care will be taken to ensure that each proposal is grounded in the analyzed experience in the micro-watersheds.

Analysis of the experience acquired in the three participating municipalities in efforts to support climate resilient micro-watershed management processes will be the basis of a proposal for the creation and operation of a Villanueva River sub-watershed committee. MARENA, together with the municipalities and other participating entities in the municipal cabinets, will submit this proposal to the National Water Authority.

The programme team will also assist the Climate Change Directorate in MARENA in workshops with the other six municipalities with significant territory in the Estero Real River watershed. The primary goal of these workshops will be to facilitate the incorporation of climate change adaptation measures in municipal land use plans, investment plans, water use plans and any related normative instruments. The workshops will capitalize both MARENA's experience to date in this topic and the lessons learned in the upper Villanueva River basin.

Throughout the duration of the programme the coordinator will keep abreast of progress in the formation of a governing body for the Estero Real River watershed and will endeavor to facilitate active participation in this process by the municipal governments and other stakeholders in the upper watershed of the Villanueva River.

In summary, through experientially-based enhancement of institutional capacities at the micro-watershed and municipal levels, the programme will facilitate the incorporation of climate change adaptation measures in work plans, policies, and normative instruments in the Villanueva River basin, and the watershed of the Estero Real River.

Component 4 – Ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality.

Baseline (without AF resources)

For over a decade, the capacities for prevention and early warning systems have been strengthened to address disaster risks. The National Environmental Information System (SINIA) has developed information and diagnostic studies on various environmental variables in several areas of the country, as well as monitoring and evaluation systems that support more targeted and informed decision making processes. Recently, MARENA launched a Regional Environmental Information Center—the Pacific North Node León—which has a database on environmental management and health, as well as research and diagnostic studies conducted in the Departments of León and Chinandega.

Although SINIA effectively compiles national data, maps and reports generated by MAGFOR, INETER and MARENA's own projects and territorial delegations, the system has not yet linked

its information gathering and processing capacities directly with community-level processes for developing and implementing land use and water management plans at the farm, micro-watershed and sub-watershed levels. In some areas, crucial information is missing. In the Villanueva River basin, for example, despite the apparent causal links between soil erosion in the upper watershed and annual flooding in the lower watershed, there has been no hydrological study to determine if and how the existing impacts of accumulated sediment can be mitigated through hydraulic works so that improved soil management will be able to significantly reduce flooding in the future. Where information does exist, there is a large gap between the amount and organization of the data available on line in urban centers and the information with which rural producers and community organizations make their decisions.

Additionality (with AF resources)

MARENA will undertake a hydrological study of the lower part of the Estero Real River watershed, identifying the hydraulic works needed to reduce the flooding caused by accumulated sediments from the upper Villanueva River basin.

With assistance from INETER and MAGFOR, students of agro-ecology and interested members of local farm families will be trained to monitor water flows and quality, soil conditions, and land use changes at the farm and micro-watershed levels. This information will be digitalized at electronic information posts in each targeted micro-watershed. The information posts, working together with the regional node of SINIA, will select and present relevant national and global climate information. This information, digitalized local monitoring data, and maps of local land use, water flow and soil quality changes will be provided to farm families and local organizations in the micro-watersheds, as well as to the members of municipal cabinets and the interested users of SINIA.

As a result, the information gap will be reduced and SINIA's usefulness enhanced; local farm families will have access to available relevant data, including the data compiled in their own micro-watersheds; and the results and lessons learned about building climate change resilience in vulnerable rural communities will be nationally disseminated.

The results of the action-research undertaken by the programme in the Villanueva River sub-watershed will be made available to relevant stakeholders in other countries that face similar difficulties in implementing national climate change adaptation strategies in impoverished rural communities.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for programme implementation

The Government of Nicaragua will execute this four year programme with UNDP support under the National Implementation Modality (NIM). The Ministry of the Environment and Natural Resources (MARENA), as the regulatory and normative entity responsible for implementation of the country's environmental policy, will be the executing agency. MARENA will be responsible for the delivery of programme outcomes and outputs. It will be responsible for ensuring that the stated programme objective and outcomes are delivered, and that resources are allocated and disbursed as indicated in the programme Document. Similarly, MARENA will be responsible

for ensuring effective coordination between this programme and other relevant programmes in Nicaragua.

For its part, UNDP will provide support to the Director and the Coordinator of the programme, in order to maximize its reach and impact as well as the quality of its products. Moreover, it will be responsible for administering resources in accordance with the specific objectives defined in the Programme Document, and in keeping with its key principles of transparency, competitiveness, efficiency and economy. The financial management and accountability for the resources allocated, as well as other activities related to the execution of Programme activities, will be undertaken under the supervision of the UNDP Country Office. UNDP will undertake the interal monitoring of the Programme and of evaluation activities, taking into account from the outset local capacities for administering the programme, capacity limitations and requirements, as well as the effectivenes and efficiency of communications between ministries and other institutions that are relevant to the programme.

UNDP will be fully accountable for the effective implementation of this programme. As a Multilateral Implementing Entity, UNDP is responsible for providing a number of key general management and specialized technical support services. These services are provided through UNDP's global network of country, regional and headquarters offices and units and include assistance in: programme formulation and appraisal; determination of execution modality and local capacity assessment; briefing and de-briefing of programme staff and consultants; general oversight and monitoring, including participation in programme reviews; receipt, allocation and reporting to the donor of financial resources; thematic and technical backstopping; provision of systems, IT infrastructure, branding, and knowledge transfer; research and development; participation in policy negotiations; policy advisory services; programme identification and development; identifying, accessing, combining and sequencing financing; troubleshooting; identification and consolidation of learning; and training and capacity building.

As outlined in UNDP's application to the Adaptation Fund Board for accreditation as a Multilateral Implementing Entity, UNDP employs a number of programme execution modalities determined on country demand, the specificities of an intervention, and country context. Under the national execution modality proposed to be used for this programme, UNDP selects a government entity as the Executing Entity based on relevant capacity assessments performed by UNDP. Please note that UNDP uses slightly different terminology to that used by the operational policies and guidelines of the Adaptation Fund. In UNDP terminology, the "executing entity" is referred to as the "Implementing Partner" in countries which have adopted harmonized operational modalities and the "Executing Entity" in countries which have not yet done so. The Executing Entity is the institutional entity entrusted with and fully accountable to UNDP for successfully managing and delivering programme outputs. It is responsible to UNDP for activities including: the preparation and implementation of programme work plans and annual audit plans; preparation and operation of programme budgets and budget revisions; disbursement and administration of funds; recruitment of national and international consultants and programme personnel; financial and progress reporting; and monitoring and evaluation. As stated above, however, UNDP retains ultimate accountability for the effective implementation of the programme.

MARENA will prepare an annual Work Plan that incorporates programme activities and results to be delivered through it. The Plan will define the execution time frame for each activity and the parties responsible for its implementation. The first Work Plan will be finalized and incorporated into the programme Document within 30 days of its signature. The participation of programme counterparts will be essential for the success of the planning phase, during which the Annual Work Plan will be prepared.

Once the programme is approved and an annual operational work plan has been prepared, the UNDP office in Nicaragua may in specific cases agreed with the programme partners charge the programme directly for its Execution Support Services, based on transactions and using a universal price list.

Given the various components that make up the programme and in order to achieve greater impact during implementation, various institutional stakeholders will participate in their areas of authority. Such inter-institutional articulation is mandated in several instruments that express the will of the Government to implement the measures of adaptability to climate change.[33]

The programme will be coordinated through a Programme Coordination Committee (PCC), which will provide support for the operational management. The PCC will be chaired by the Director General of Planning of MARENA, and include a representative of UNDP-Nicaragua, a representative of the Ministry of Agriculture and Forestry (MAGFOR), as the governing body of the Agriculture Sector, and a representative selected jointly by the municipal governments of El Sauce, Achuapa and Villanueva.

The PCC will be assisted by an Inter-Agency Support Committee (IAC) composed of representatives of the Nicaraguan Institute of Territorial Studies (INETER), the National Water Authority (ANA), the Rural Development Institute (IDR) and the Nicaraguan Institute of Agricultural Technology (INTA).

The PCC will meet at the beginning of the programme and then at the end of three months, in order to verify the mechanisms established for programme implementation. At these two moments, the representatives of the Inter-Institutional Support Committee will be present in order to confirm that the commitments of each of the institutions within the scope of their areas of competence are clearly defined in the programme Work Plan. Thereafter, the PCC and the IAC will meet every six months.

The programme execution structure will be constituted by a National Programme Director (NPD) and a Programme Coordinator supported by a technical team. The National Programme Director will be the Director of Climate Change of MARENA. The establishment of an NPD is a requirement within the Nicaraguan protocol for management of external grants. The NPD will act as the administrative and executive manager of the activities described in the Programme Document.

The NPD will work with the Programme Coordinator (PC). Through monthly meetings, the PC will coordinate with the Departmental Delegation of MARENA-León.

[33] Resolution A. N. No. 003-2009, approved on June 17, 2009. *On Climate Change and its Adaptability in Nicaragua – National Environment Strategy and Climate Change,* ***National Human Development Plan****.*

MARENA will follow the rules and procedures detailed in the UNDP NIM Manual for programme execution. The UNDP will provide support to the NPD and the CP, in order to maximize the programme's impact as well as the quality of its products. Moreover, it will be responsible for administering resources in accordance with the specific objectives defined in the programme Document, and in keeping with the key principles of transparency, competitiveness, efficiency and economy. The financial management and accountability for the resources allocated, as well as other activities related to the execution of programme activities will be undertaken under the direct supervision of the UNDP Country Office.

The PC will be located in the programme area and will be supported by a technical team. The technical team will consist of three outreach workers, a civil engineer specializing in rural water works, and an administrator. Each of the three outreach workers will work as a facilitator in the targeted micro-watersheds of one of the municipalities in the upper Villanueva River Sub-Watershed. The civil engineer will have overall responsibility for oversight of water works construction contracts provided for in Component 1.The PC will be contracted for four years, while the administrator and outreach workers will have 22-month contracts renewable for 24 additional months[34]. The civil engineer's contract will be for 22 months, renewable for another 12 months, assuming that all water works are built by the end of the third year of the programme.

Climate change poses a serious threat to agricultural production activities due to the close relationship between water resources and soil resources. That is why the context of adaptation must be addressed through a series of fundamental changes regarding the use and management of these resources—changes that need to be culturally accepted. It is therefore appropriate that the PC be a professional with expertise in promoting processes of social and organizational change and with knowledge about Nicaraguan government at the national and, in particular, the municipal levels. This profile can be met by a university graduate in anthropology, sociology, social psychology, or adult education. Alternatively, it could be a professional in agronomy with experience in introducing a gender approach in adaptive management of river watersheds.

Both the PC and the outreach workers will act as facilitators of the processes for coordination at the municipal level, where they will work hand in hand with producer associations, the municipal agricultural production cabinets, and any and all relevant bodies for citizen participation and civic and institutional harmonization that facilitate the learning processes and technology transferences that take place within the framework of the programme. In each of the municipalities of El Sauce, Achuapa and Villanueva the outreach workers will facilitate and/or support the integration of a Municipal Technical Team (MTT) composed of the staff of the Municipal Environmental Management Unit (UGAM), MAGFOR, INTA, INAFOR, the National Union of Agricultural Producers (UNAG), and relevant local cooperatives, producer associations, NGOs and other organizations involved in the production cabinet or any other established forum for inter-institutional harmonization.

[34] The PC should have two months to participate in the selection of technical team members; hence the other contracts will begin two months after the PC's contract, which will start at the beginning of the project.

At the community level, efforts will be coordinated with existing water users' associations, churches, political parties, cooperatives and other forms of affiliation that facilitate the processes of information transmission and learning. In these spaces, the facilitation team will do what is needed to ensure that people have the elements and information needed to request support and technical assistance as required from the MTT members as well as other institutions with responsibilities in the area of rural development.

Implementation by Component

Component 1

The Municipal Procurement Act, Law 622, published in La Gaceta No. 119 of June 25, 2007, establishes rules and procedures to regulate the procurement and contracting of works, goods and services, leasing, consulting and construction of public works that in the exercise of its powers, are carried out by a Municipality. These processes have the same legal certainty as those carried out under the ***Government Procurement law***. Law 622, however, is better adapted to the actual situation in rural areas of the country, and its processes are much more expeditious.

To avoid delays and promote local economic development, the procurement of infrastructure works will be undertaken under Law 622, recognizing that in each of the three municipalities there is a procurement office with staff trained to carry out these processes. To this end, MARENA will celebrate agreements with each of the Municipal Governments of El Sauce, Achuapa and Villanueva so that the latter can receive a quarterly transfer for the implementation of Programme works contained in the municipal budget for that period.

During the first months of the Programme, the necessary documentation will be prepared to start the processes for contracting the execution of works in the next dry season. Prior to the construction contracts the commitments of the beneficiaries of the works should be determined: both their commitments before and during construction, and for post-construction maintenance. In year 2 (and, if necessary, in year 3) of the programme, the same procedures will be used for the works that were not identified in the first year.

Under coordination of the PC, the person responsible for the implementation of Component 1 will be the civil engineer on the programme technical team.

Component 2

The programme team outreach workers will work with the communities, facilitating hands-on learning processes, in coordination with the other members of the MTTs. To attain local ownership of programme activities, the outreach worker will normally stay for several consecutive days in each community.

At the start of the programme the PC will work closely with INTA to define the terms of an extension of its agreement with UNAN-Leon and to consider the possibility of complementing this agreement with agreements with INATEC-El Sauce and CURS-Somotillo to ensure that students of agro-ecology—and possibly agronomy—are able to undertake work study programs in the micro-watersheds in terms that enable them to gain the knowledge, capabilities and practical skills needed to facilitate the planning and implementation of agro-ecological practices

by farm families. Thirty-two students are required: four each year in each micro-watershed for three months. They will stay with families in the communities, paying for their room and lodging out of financial support provided by the programme.

The purchase of materials to be supplied to the farm families for implementation of the agro-ecological practices contemplated in their farm transformation plans and approved by the corresponding outreach worker will be undertaken by the Municipal Procurement Offices following the same procedures described for the works contracting contemplated in Component 1.

Under the coordination of the PC, the person responsible for the implementation of Component 2 in each micro-watershed will be the Programme outreach worker assigned to the municipality.

Component 3

Supervision and coordination of Component 3 activities is the direct responsibility of PC. At both the micro-watershed and municipal levels, the PC will work closely with the corresponding Programme outreach worker and other members of the MTT.

For additional support at the micro-watershed level, at the start of the Programme the PC will work closely with INTA to define the terms of an extension of its agreement with the Department of Anthropology at the UNAN-Managua, so that anthropology students can conduct practical work studies in the micro-watersheds. Under the coordination of the PC and with the support of the Department of Anthropology, anthropology students will advise the outreach workers on the programme team, other MTT members, and the agro-ecology students participating in each micro-watershed about ways to ensure that climate resilient agricultural practices are culturally accepted and farm families take ownership of them. An anthropology student is required in each micro-watershed during three months each year. They will stay with families in the communities, paying for their room and lodging out of financial support provided by the Programme.

Component 4

Early in the first year of the programme the MARENA will tender the contract for a hydrological study on the causes of floods in the lower part of the Villanueva River Sub-Watershed. Once the study has identified the necessary hydraulic works, MARENA will work with PNUD to identify potential sources of funding, communicating the results of the study to the Presidency of the Republic, MAGFOR, MTI, other relevant national government institutions, the municipalities of Somotillo and Villanueva, agricultural producers in the area, and donor agencies.

Supervision and coordination of other Component 4 activities will be a responsibility of the coordinator of the SINIA Regional Node, in coordination with the PC. A fulltime staff position in the Node will be financed by the programme to ensure effective coordination of the Component, along with eight positions for computer technicians with the ability to generate digital maps. The technicians will be located in the micro-watersheds where they will reside in the local communities for 4 years.

For implementation of the activities in each micro-watershed, the programme outreach worker assigned to the corresponding municipality will provide support in identifying appropriate locations for the electronic information post and micro-watershed office.

Describe the measures for financial and programme risk management.

Risk		Responsive Measure
Farm families do not understand the imperative and/or the possibility of responding to and planning for climate change risks.	M	The programme will provide up-to-date climate change information and programmeed scenarios to communities in the micro-watersheds and will accompany farm families on visits to farms that have adopted new practices which – in combination with water catchment works – represent a feasible path for adaptation.
Limited access to credit may limit the adoption of new technologies.	M	Rain water catchment works and irrigation systems will allow farm families to have at least one harvest per year. This is a notable risk reduction that should make farmers more solvent and facilitate access to credit. The Programme will provide seed capital for the first new agro-ecological investments and thereafter will liaise with funding institutions including the new government bank *Banco Produzcamos* which aims to increase funding for small and medium sized producers, and to give a preference to agro-ecological production.
Key national and municipal stakeholders do not come to an agreement to promote an adaptation strategy at the watershed level.	L	During implementation, strong mechanisms for collaboration will be advanced in the watershed, based on government policies relating to Climate Change and Agro-ecology. The programme will work closely with municipal level harmonization entities, especially the Agricultural Production Cabinets.
Natural events delay programme execution.	M	Construction works will be scheduled for the dry season.

A comprehensive risk management strategy will be a core component of programme management activities. This is in line with UNDP's stringent risk management approach which is corporate policy. The respective UNDP CO provides support to the programme team and executing agency for constant and consistent risk monitoring, and the results are tracked and reported in UNDP's internal risk monitoring system. The results are also reported in the yearly evaluation undertaken for each programme. The risks identified concern issues that are at the core of what the programme seeks to achieve in terms of establishing locally-driven adaptive planning to face climate-induced difficulties at the farm, community, micro-watershed, sub-watershed and watershed levels. Lesser risks, specific to each component, will be addressed in annual workplans and monitored accordingly.

In addition to this, and again in keeping with UNDP practice, a dedicated budget line exists for Monitoring and Evaluation, to ensure that the necessary resources are allocated to execute the Monitoring and Evaluation framework.

A. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.
Programme monitoring and evaluation (M & E) will be carried out by the Programme Team and the UNDP-Country Office in accordance with established UNDP procedures. The Results Framework defines performance indicators as well as their means of verification.

Type of M&E Activity	Responsible Parties	Budget US$ *Does not include time of the Programme personnel*	Time Frame
Inception Workshop	Programme Coordinator UNDP-CO	$500	Within first two months of programme start up.
Initial Report	Programme Team UNDP-CO	None	Immediately after Inception Workshop.
Measurement of Means of Verification for Programme Purpose Indicators	Programme Coordinator	None	Start, mid and end of programme
Measurement of Means of Verification for Programme Progress and Performance (measured on an annual basis)	Programme Coordinator	None	Annually, prior to yearly reports and to the definition of annual work plans
Monthly Reports	Programme Team	None	At the end of each month
Annual Reports	Programme Team MARENA UNDP-CO	$500	At the end of each month
Programme Coordination Committee Meetings	Programme Coordinator UNDP-CO	None	After the Inception Workshop and thereafter at least once a year.
Technical Reports	Programme Team External Consultants	None	To be determined by the Programme Team and UNDP CO
Mid-Term External Evaluation	Programme Team UNDP-CO External Consultants	$ 20,000	At the mid-point of programme implementation
Final External Evaluation	Programme Team UNDP-CO External Consultants	$ 20,000	At the end of programme implementation
Final report	Programme Team UNDP-CO	None	At least one month before the end of the programme
Publication of Lessons Learned	Programme Team	$ 17,500 (average of $ 3,500 per year)	Yearly
Audit	UNDP-CO Programme Team	$ 45,000 (average of $ 11,250 per year)	Yearly
Field Trips (UNDP staff travel costs to be charged to IA fees)	UNDP-CO MARENA	$2,000	Yearly

Type of M&E Activity	Responsible Parties	**Budget US$** *Does not include time of the Programme personnel*	Time Frame
Total Indicative Cost		**$ 105,500**	

B. Include a results framework for the programme proposal, including milestones, targets and indicators.

Objective: Reduce risks from drought and flooding generated by climate change and variability in the watershed of the Estero Real River					
	Indicators	**Baseline**	**Final Programme Goals**	**Sources of Verification**	**Risks and Assumptions**
Programme Objective Reduce risks from drought and flooding generated by climate change and variability in the watershed of the Estero Real River	Number of farm families in the targeted micro-watersheds with at least one annual harvest.	400	1005[35]	Monitoring records in each micro-watershed	Climate change information and agro-ecological demonstrations convince farm families of the need and possibility of adaptation.
	Number of farm families included in Sub-Watershed management proposal.	0	7120[36]	Sub-watershed management proposal	
Outcome 1 Increased availability of water for small scale domestic and productive uses and reduced risk of water stress and drought.	Percentage of farms in each micro-watershed with access to irrigation by means of hydraulic works built with programme funds.	0%	90%	Records of farms and works built.	Municipalities administer funds effectively. Cost estimates are accurate. Construction in dry season is undisturbed by weather events.
	Percentage of farmers in each micro-watershed, the water use of which is rated as satisfactory in relation to the relevant technical guidelines.	5%*	90%	Record of evaluations made by programme team	
Outcome 2 Enhanced food security and eco-systemic resilience through agro-ecological practices and effective use of available water in the eight targeted micro-watersheds.	Percentage of farm families in each micro-watershed implementing agro-ecological farm transformation plans.	5%*	80%	Monitoring records of farm plans in each micro-watershed	Technical teams establish effective communication with farm families. Financing available to farm families for expanded agro-ecological production.
	Increase in percentage of land in each micro-watershed with vegetation coverage.	25%*	50%	Digitalized maps based on farm plans	
Outcome 3 Enhanced institutional capacities for the incorporation of climate change adaptation measures in work plans, policies, and normative instruments in the Villanueva River sub-watershed, and the watershed of the Estero Real River.	An experientially-based proposal endorsed by three municipal governments for the operation of a Sub-Watershed Committee for the Villanueva River basin.	0	1	Proposal submitted to the National Water Authority	Irrigators establish and follow technically correct water use guidelines. Agricultural production cabinets and/or other inter-institutional harmonization mechanisms function at the municipal level.
	Municipalities in watershed with climate change adaptation measures included with their official plans and related normative instruments.	0	9	Municipal ordinances	
Outcome 4 Disseminated results and lessons learned about building climate change resilience in vulnerable rural communities.	Local Stakeholders in each micro-watershed measure water quality and amount, soil conditions and changes in their use.	0	8	Monthly reports of the electronic information posts	Mechanisms are available to establish electronic communications in the micro-watersheds. Information technology specialists willing to reside in micro-watersheds.
	Lessons learnt in eight micro-watersheds and the Villanueva River Sub-Watershed available in SINIA.	0	4 annual reports	SINIA WEBSITE	

*These percentages vary by watershed and will be updated at the start of the programme.

[35] Exact number of farm families currently living in targeted micro-watersheds to be confirmed at project start-up.
[36] Exact number of farm families currently living in Villanueva River Sub-watershed to be confirmed during year one of the project.

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT[37] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Denis Fuentes Ortega **Planning Director** **Ministry of the Environment and Natural Resources** **National Focal Point before the Adaptation Fund**	Date*(10/20/2010)*
Telephone and electronic mail: 505-22632862 / 22632864	

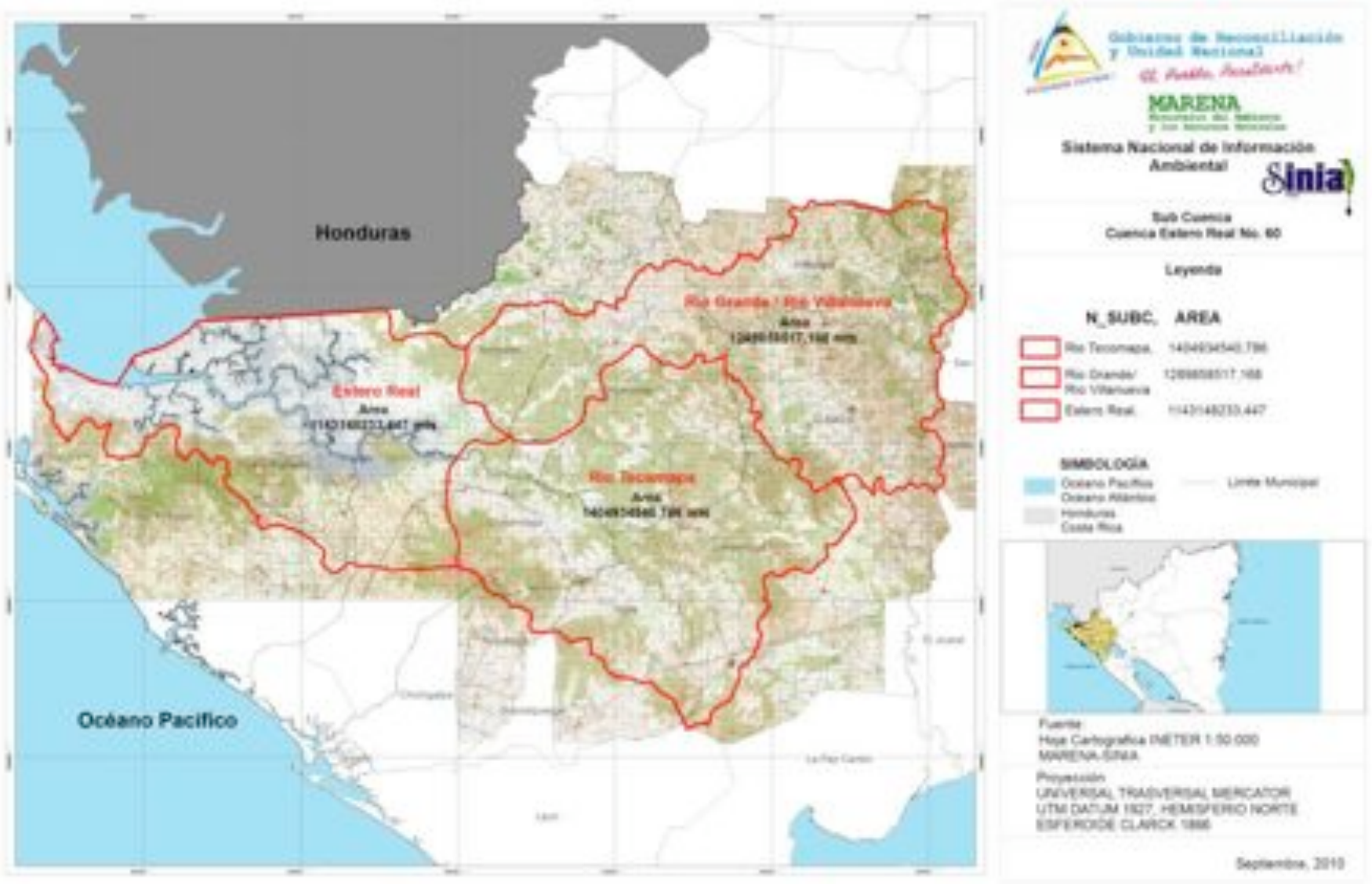
B. IMPLEMENTING ENTITY CERTIFICATION *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans, the National Environmental and Climate Change Strategy and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
 Yannick Glemarec Director Environmental Finance UNDP	
Date: *October 22, 2010*	Tel. and email:yannick.glemarec@undp.org
Project Contact Person: Julia Wolf and Pradeep Kurukulasuriya	
Tel. And Email: + 1-212-906-6843, pradeep.kurukulasuriya@undp.org	

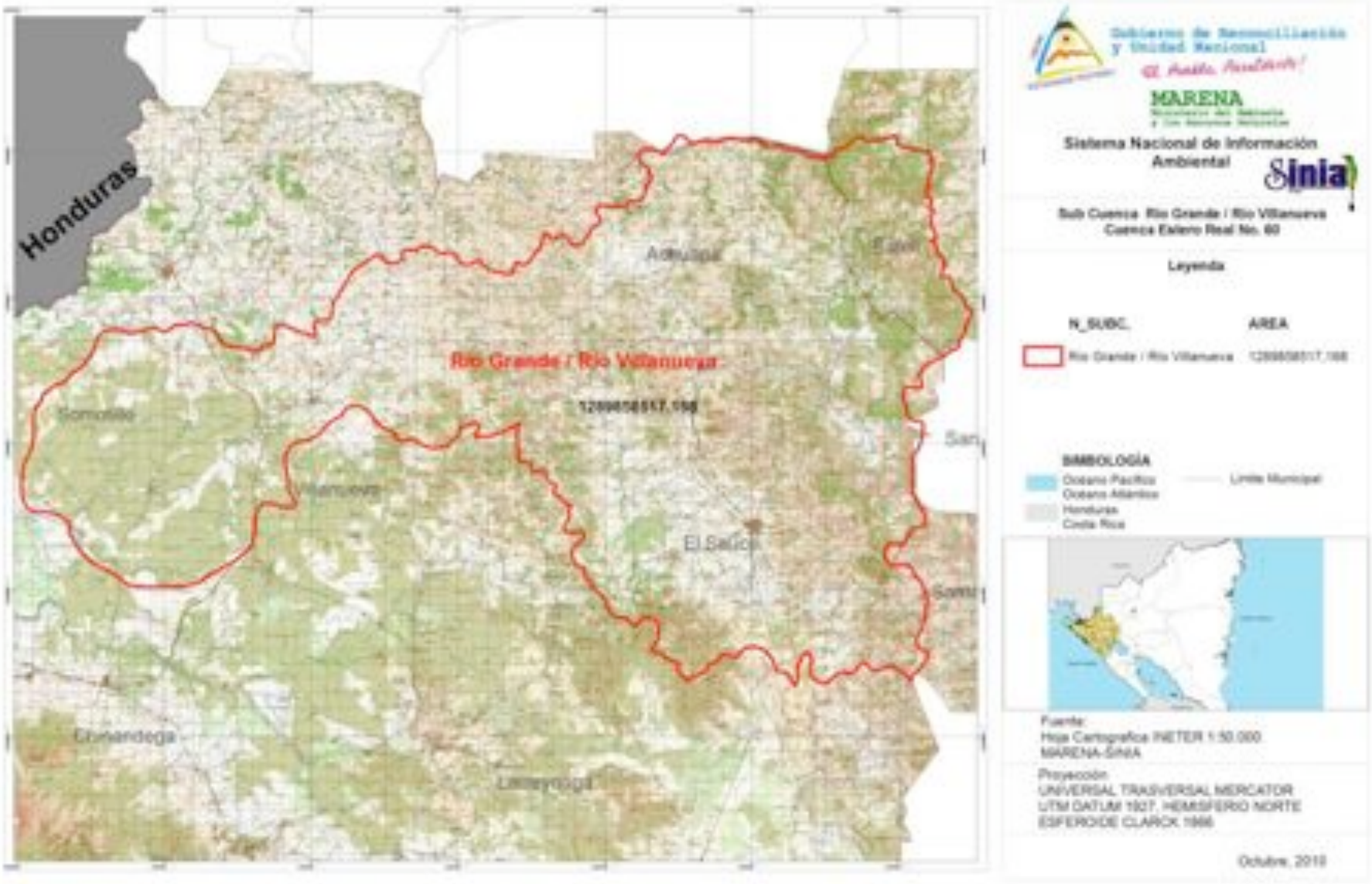
6. Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

List of Annexes

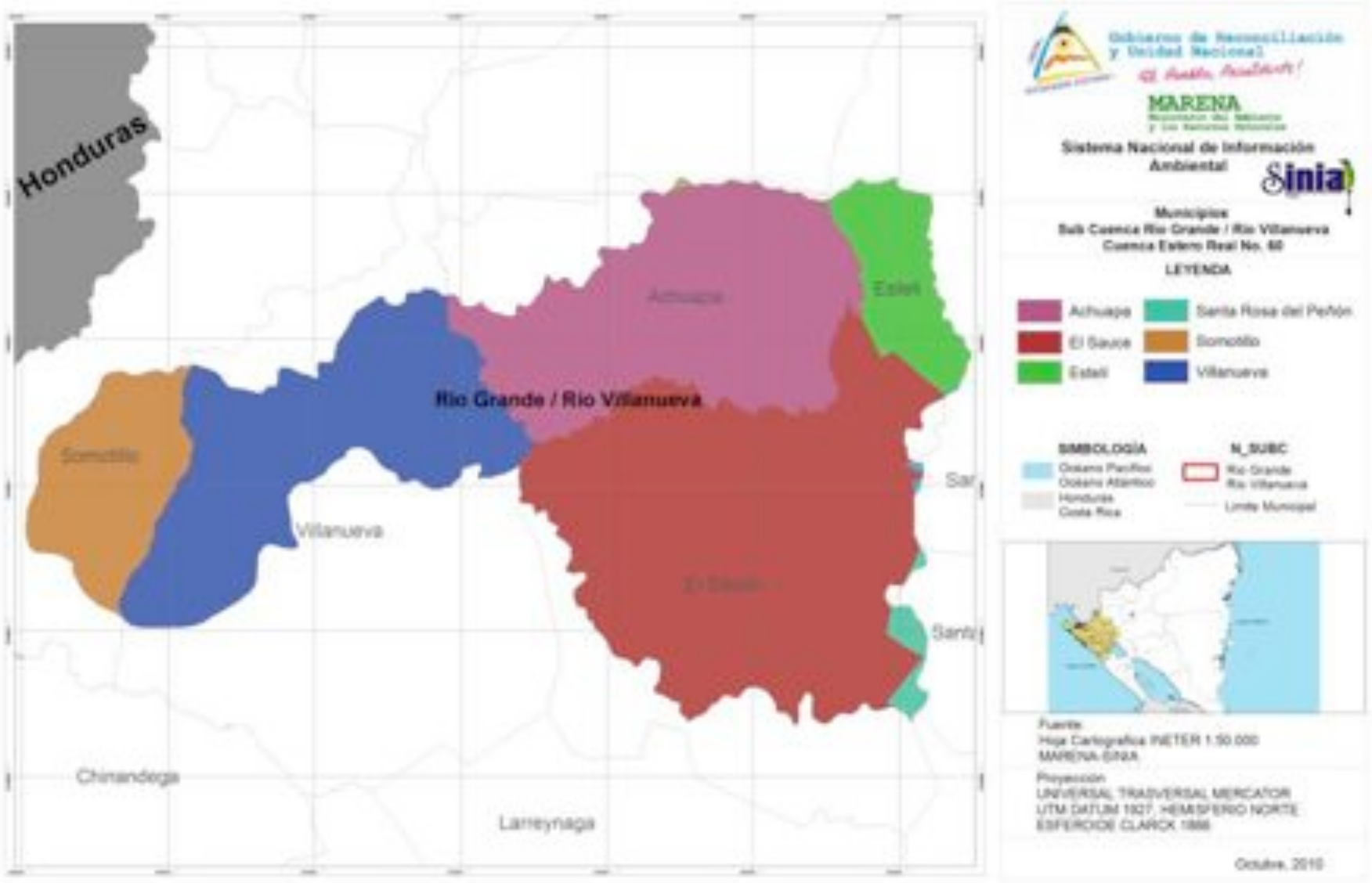
ANNEX 1



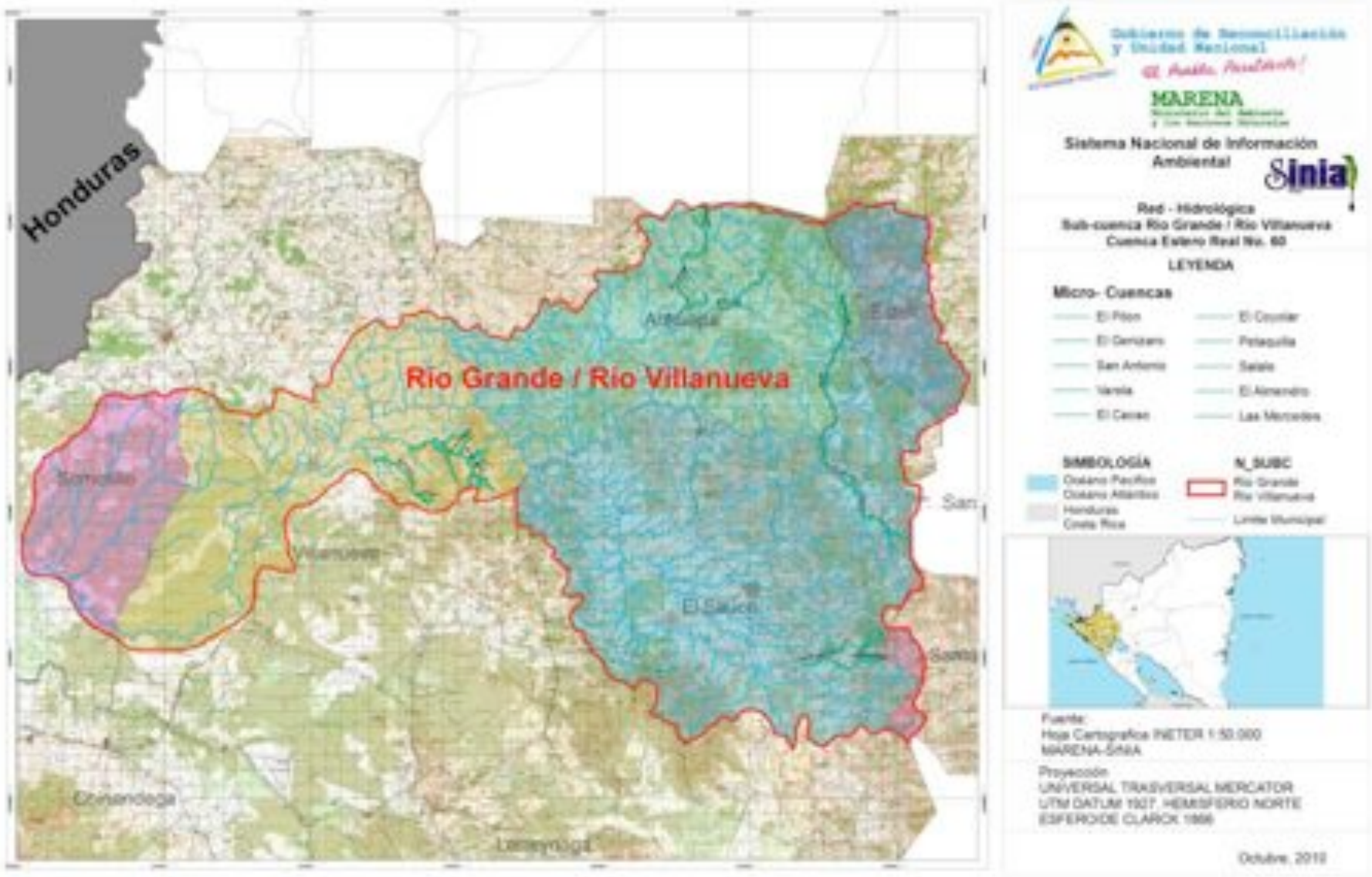
MAP 1: Sub-Watersheds of the Estero Real River Watershed



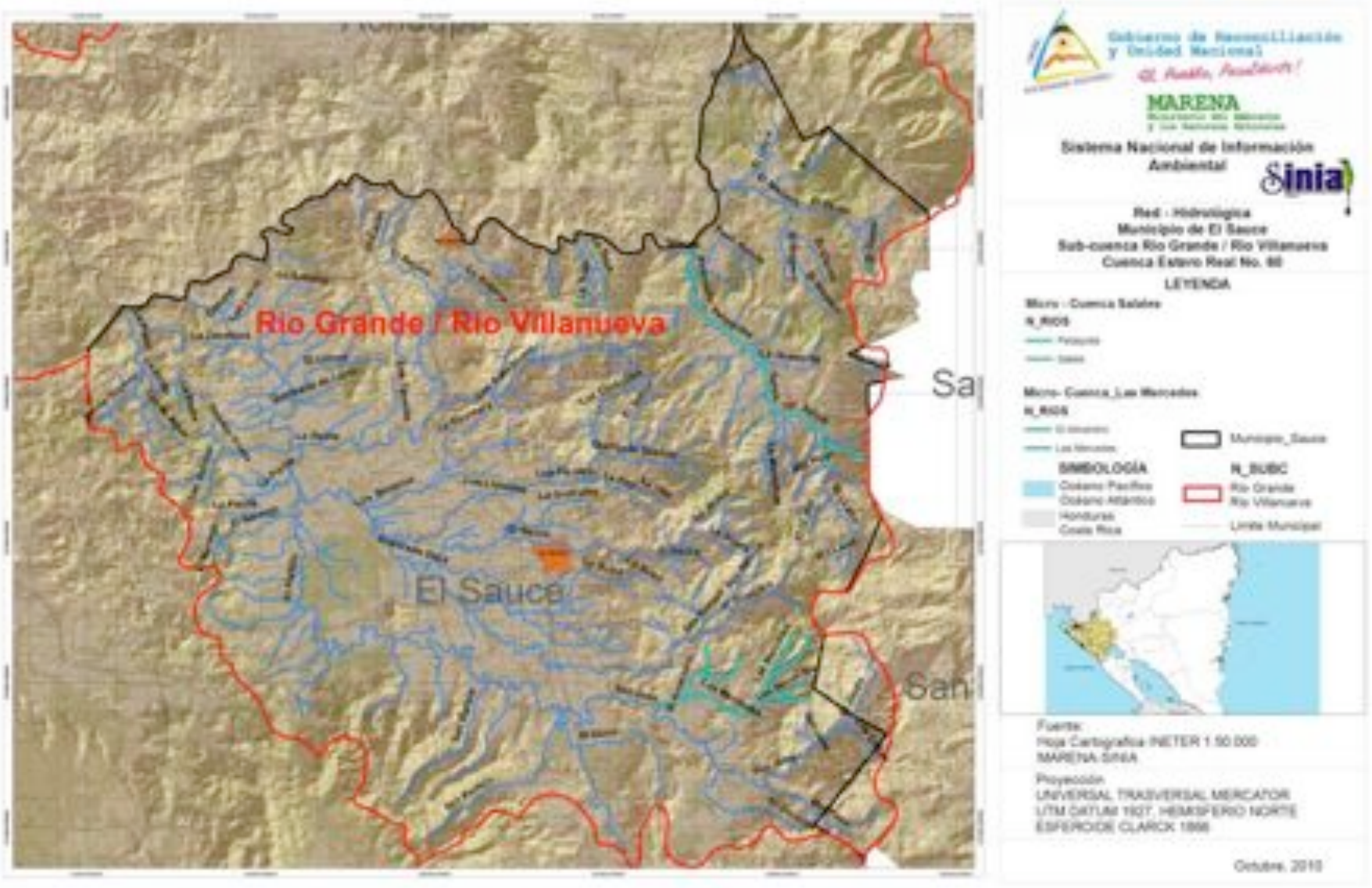
MAP 2: Villanueva (Río Grande or Aquespalapa) River Sub-Watershed



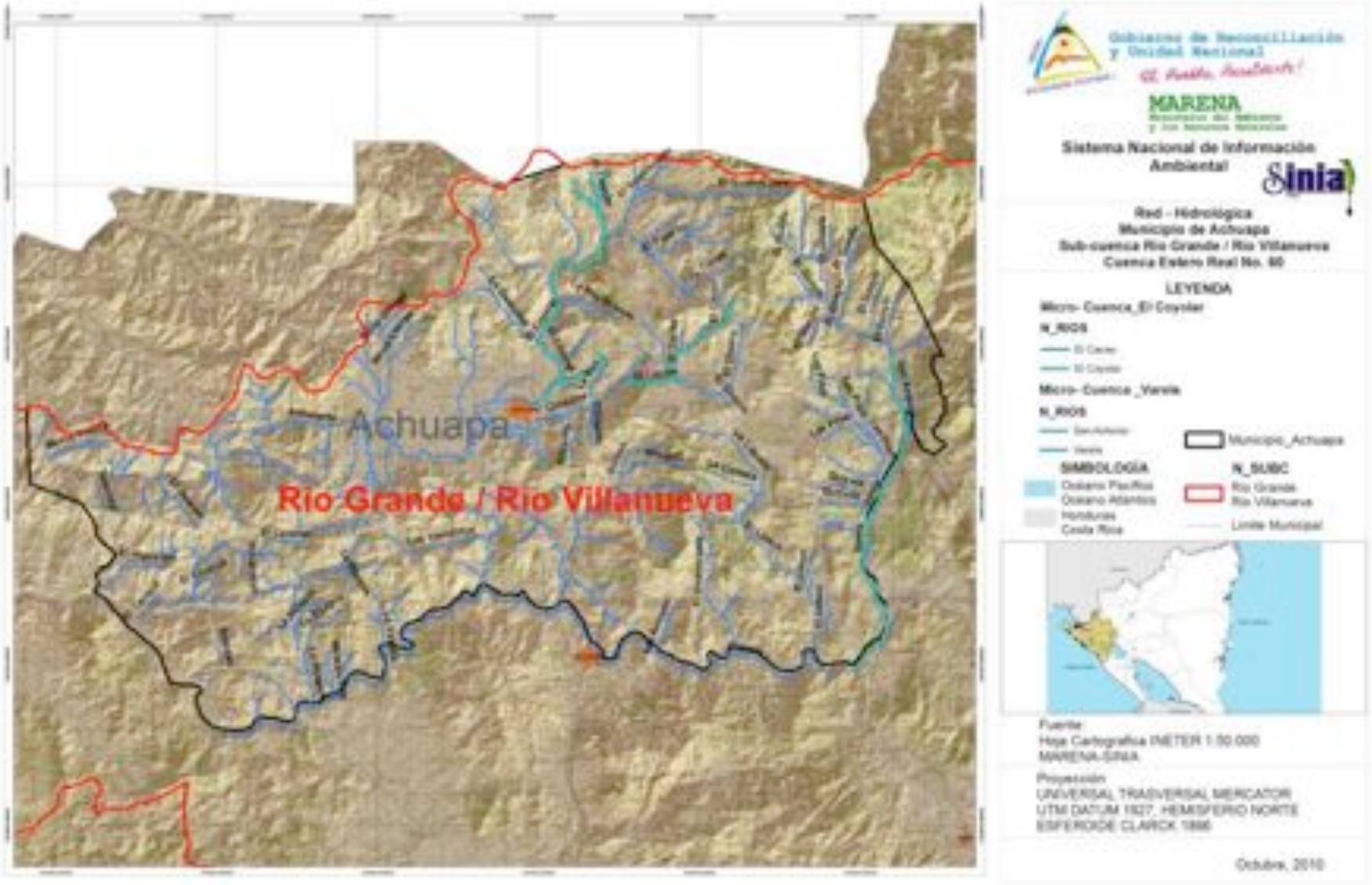
MAP 3: Municipalities in the Villanueva River Sub-Watershed



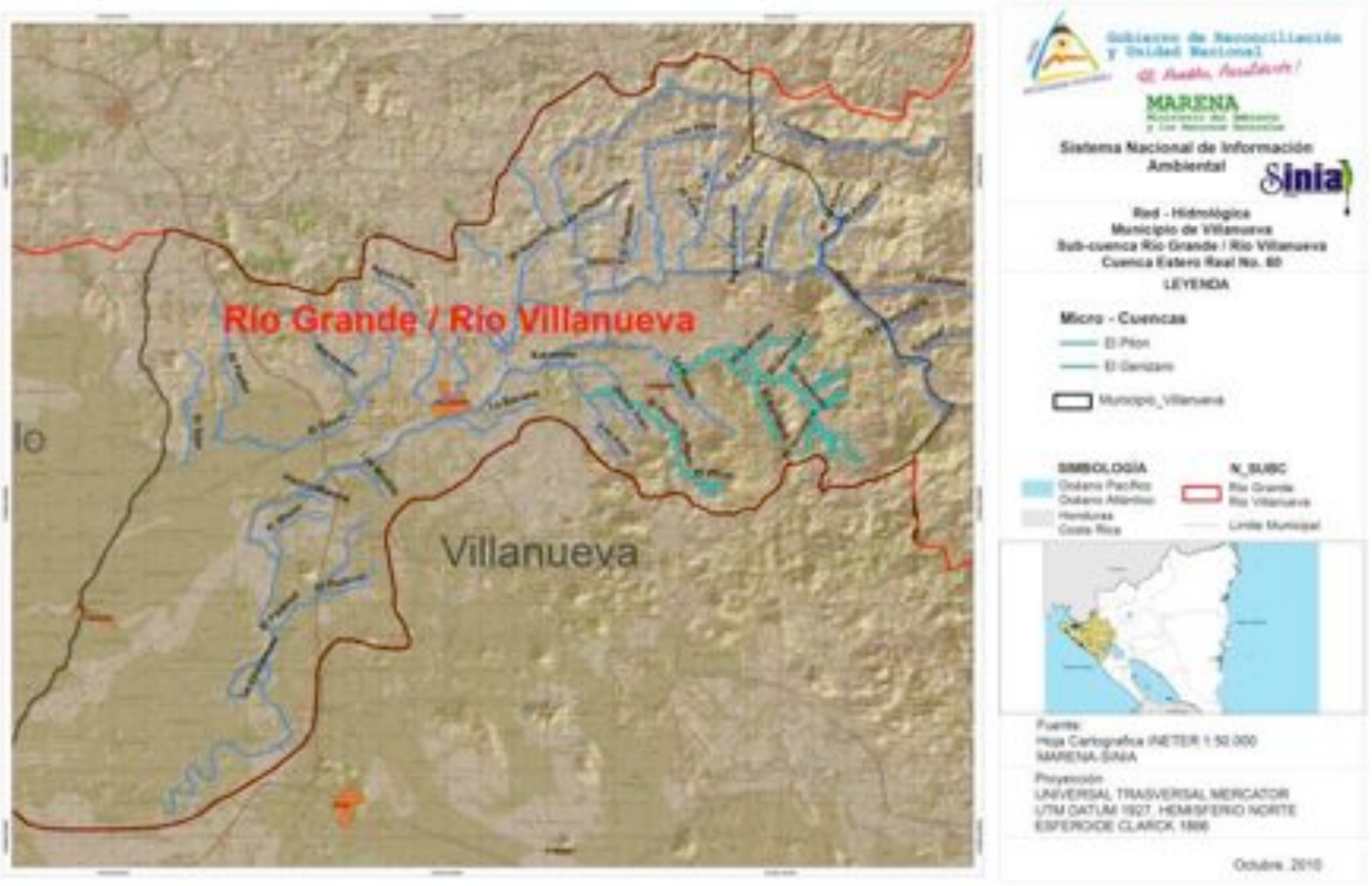
MAP 4: Villanueva River Sub-Watershed hydric network, highlighting rivers and streams of the pilot micro-watersheds



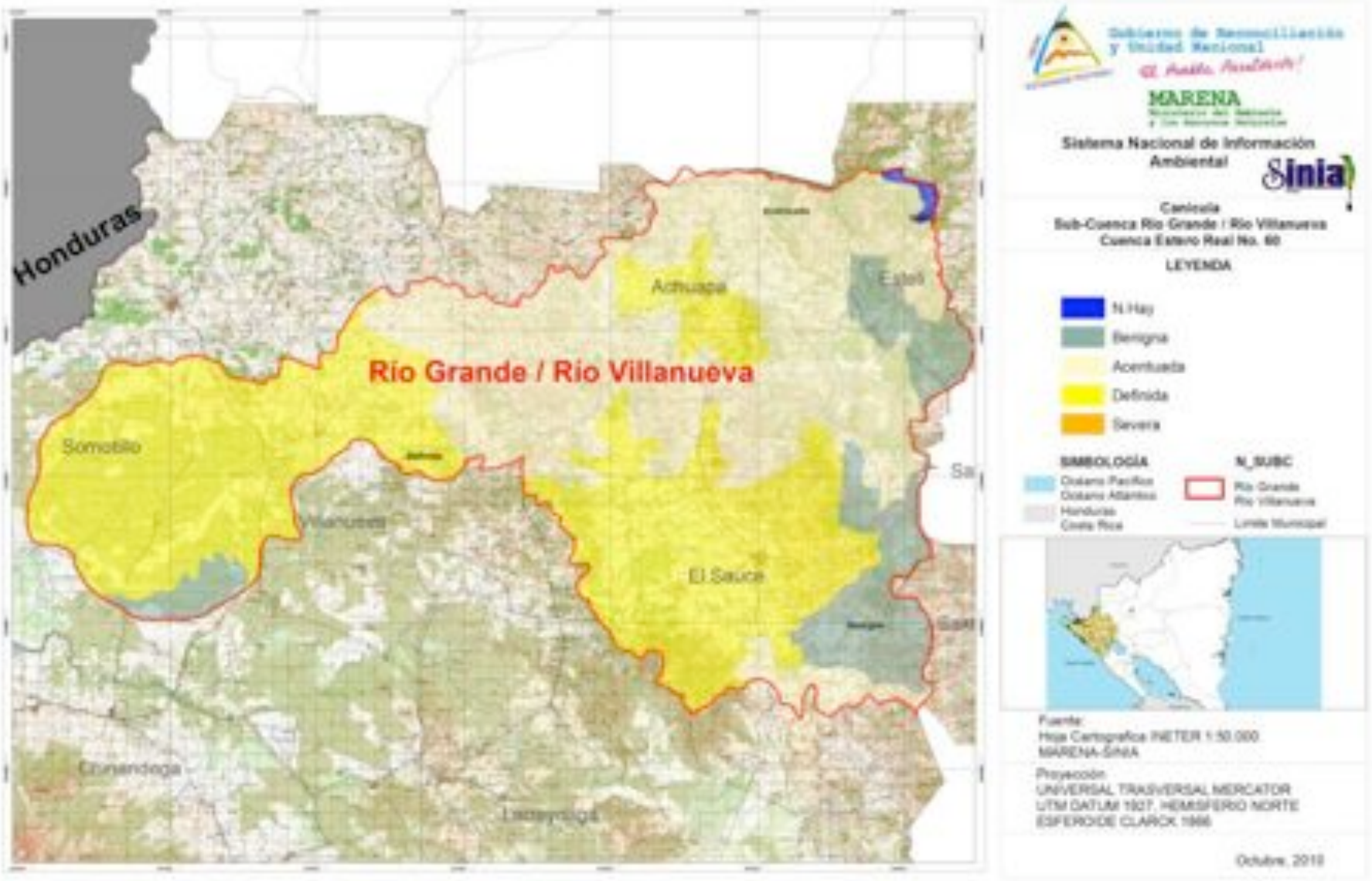
MAP 5: Rivers and streams of the pilot micro-watersheds in El Sauce



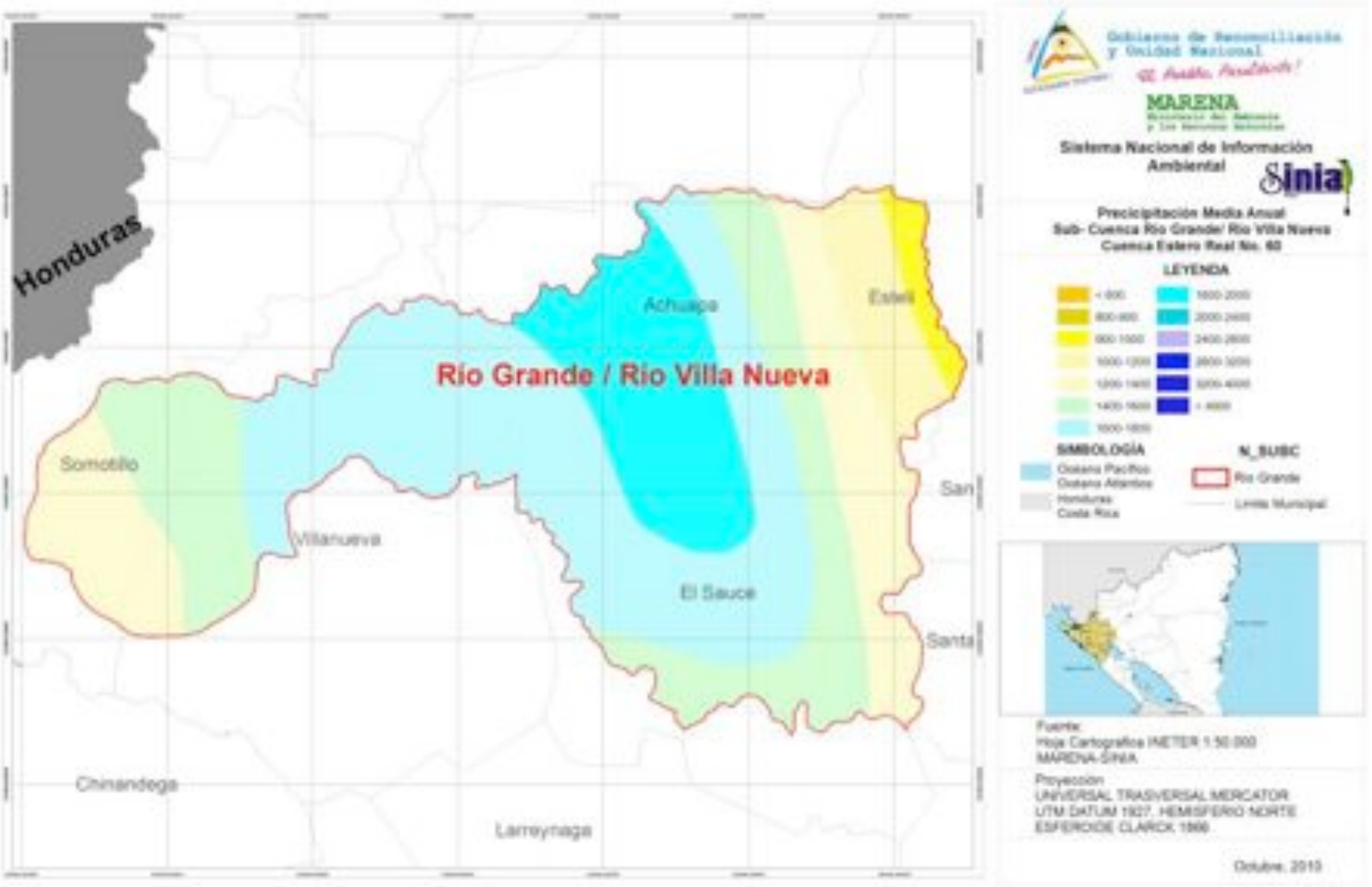
MAP 6: Rivers and streams of the pilot micro-watersheds in Achuapa



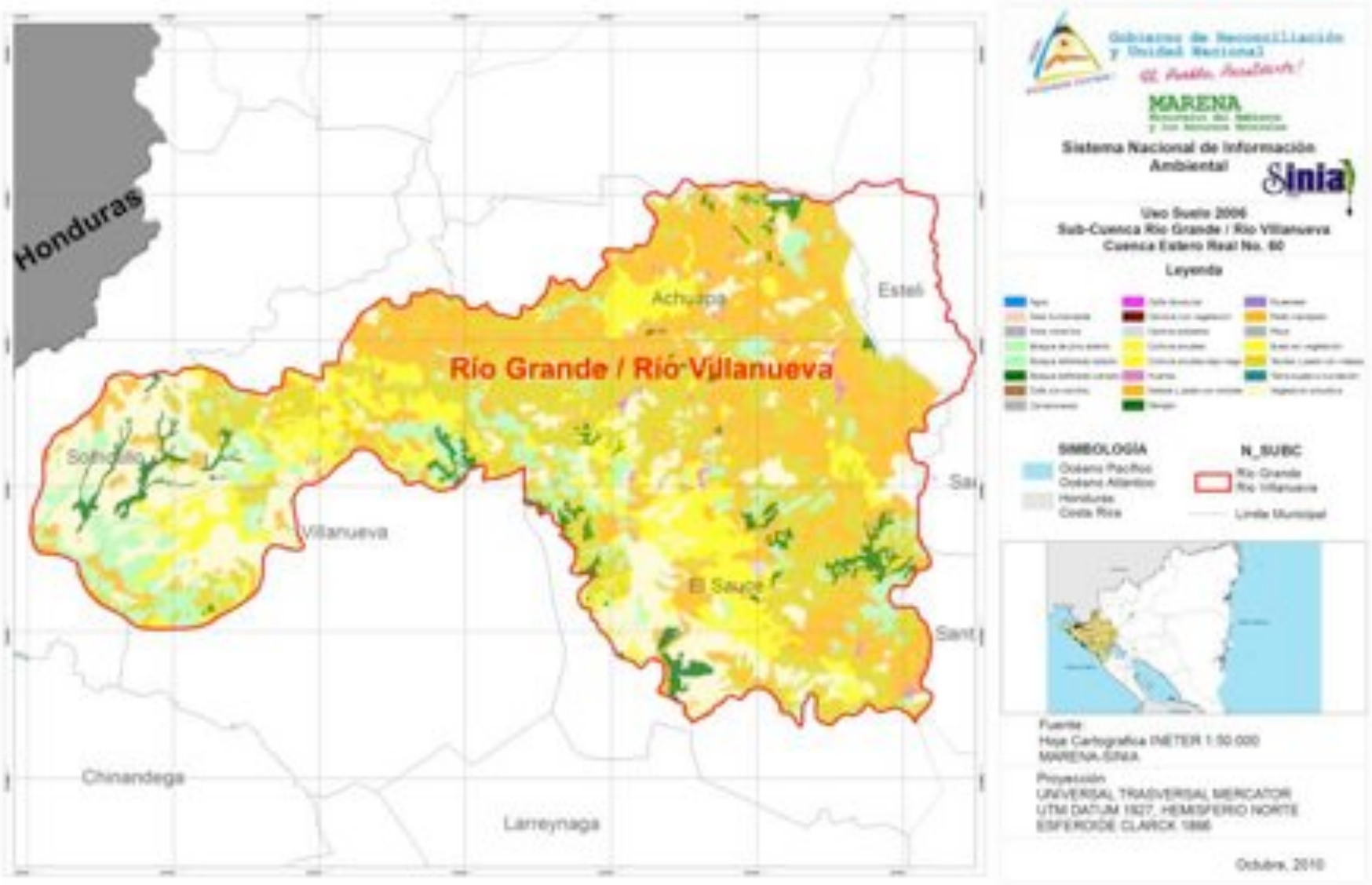
MAP 7: Rivers and streams of the pilot micro-watersheds in Villanueva



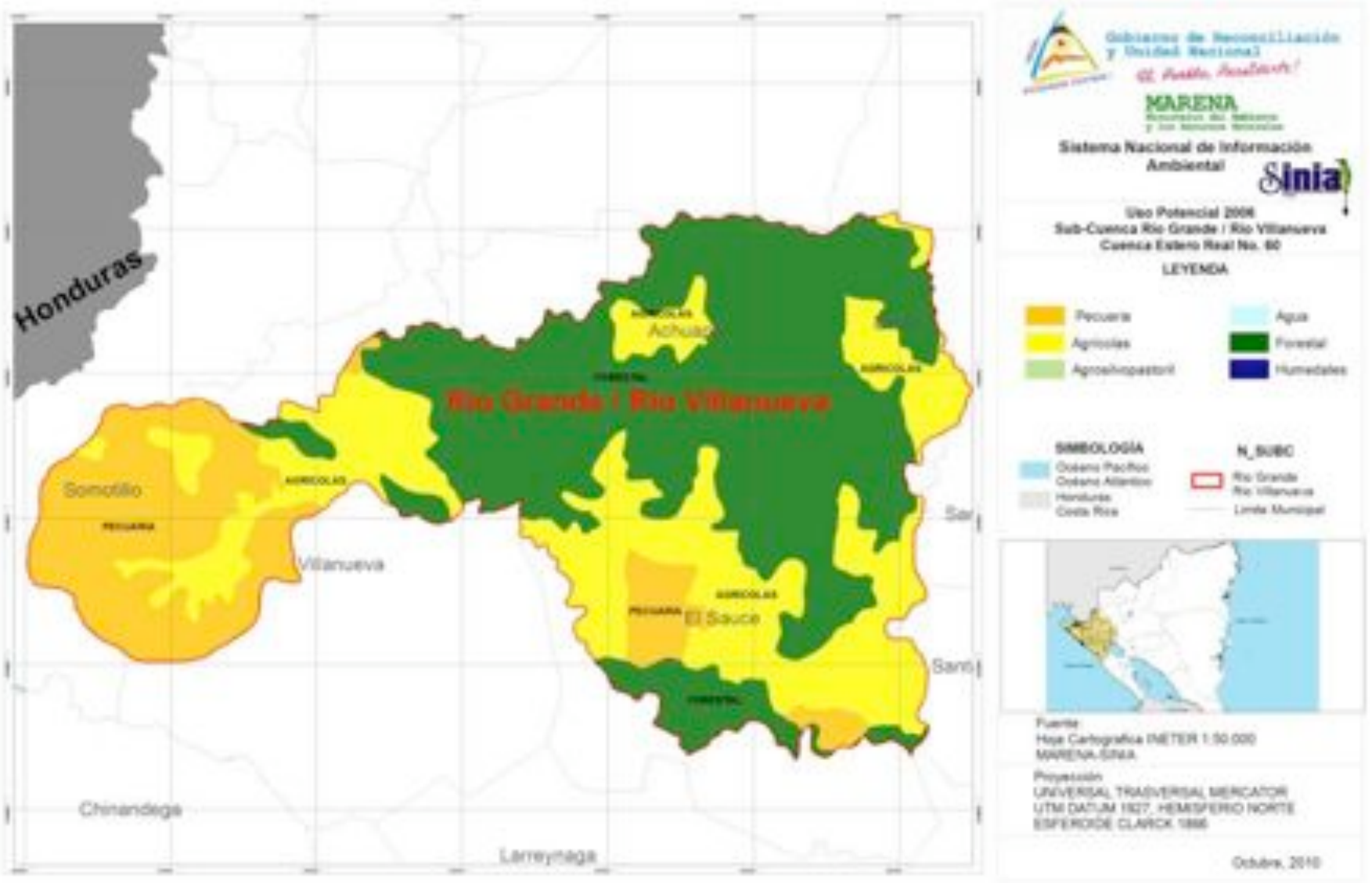
MAP 8: **"Dog-Days" severity in the Villanueva River Sub-**Watershed



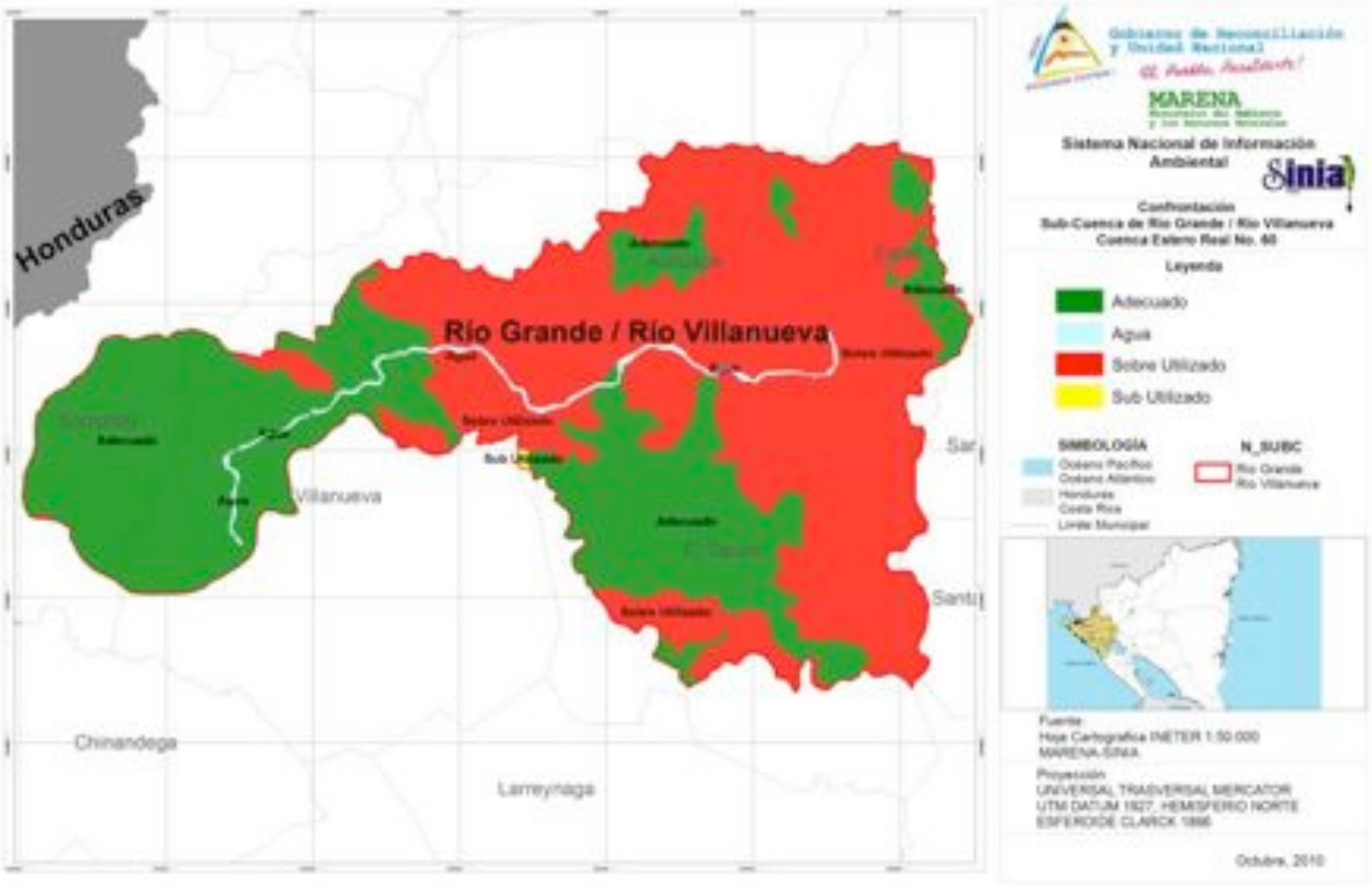
MAP 9: Annual rainfall in the Villanueva River Sub-Watershed



MAP 10: Current soil use in the Villanueva River Sub-Watershed



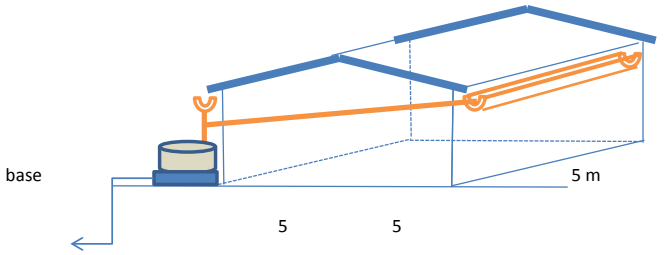
MAP 11: Soil vocations in the Villanueva River Sub-Watershed



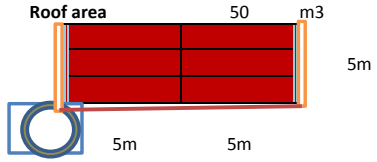
MAP 12: Over-exploitation of soils in the Villanueva River Sub-Watershed

ANNEX 2: Types, Capacities and Costs of Rain and Surface Water Catchment Structures

Roof and Cistern System. 1: Roof capture



	Roof capture			
TYPE	Área m2	mm / año	% captac	Vol litros
E	50	1000	60%	**30,000.00**
F	50	1500	60%	**45,000.00**
G	50	2000	60%	**60,000.00**
Circ	25	1000	60%	**15,000.00**
D	25	1500	60%	**22,500.00**
E	25	2000	60%	**30,000.00**
A	20	1000	60%	**12,000.00**
B	20	1500	60%	**18,000.00**



Materials	Unit	Quant.	Pu (C$)	Monto C$	$
Canal liso de 6m	ud	2	642.35	1,284.70	59.20
uniones para canal liso	ud	8	28.9	231.20	10.65
Tapas terminales	ud	4	17.5	70.00	3.23
Boquilla para 3 "	ud	2	73.8	147.60	6.80
Bajante 3"	m	3	100	300.00	13.82
Codos 45 X3"	ud	2	*67*	134.00	6.18
Ye de 45X3"	ud	1	100	100.00	4.61
Tubo PVC24 X3"	ml	12	150.25	1,803.00	83.09
				4,070.50	**187.58**

Vertical filter for drinking water

	Unit	Quant.	Pu (C$)	Monto	$
piedrin de 1/2"	lts	7.0686			
piedrin de 1/4"	lts	14.1372			
arena	lts	35.343			
esponja de 2 "	m2	0.07			
ñete de plastico	ud	1			
rifo descarga 2"	ud	1			
Tapa	ud	1			
				150.00	**6.91**

Chlorination mechanism

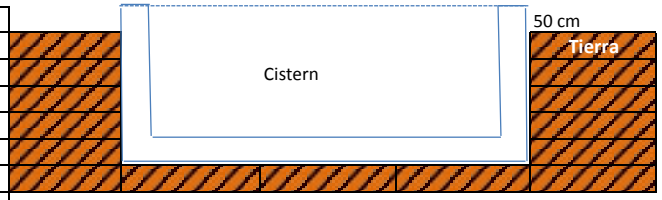
Juntas por hiladas	Bloques por hilada
33	16.5
43	21.5
53	26.5
43	21.5
53	26.5
63	31.5
63	31.5

Roof and Cistern System. 2: Cistern

							Rendimientos de Uso		lts/month
							250 lts/fam/día	800 lts/day/mz	19,500.00
	Cistern characteristics						Drinking water	Drip irr.	Mixed use
	Radio	alto	ancho	largo	Vol litros	Obs	Meses	Meses	Meses
Circ	1.5	**2**			**14,137.20**	Cilindrico	1.88	1.18	**0.72**
A		**1.5**	2	4	**12,000.00**	Rectangular	1.60	1.00	**0.62**
B		**1.5**	3	4	**18,000.00**	Rectangular	2.40	1.50	**0.92**
C		**1.5**	4	4	**24,000.00**	Rectangular	3.20	2.00	**1.23**
D		**2.5**	2	4	**20,000.00**	Rectangular	2.67	1.67	**1.03**
E		**2.5**	3	4	**30,000.00**	Rectangular	4.00	2.50	**1.54**
F		**2.5**	4	4	**40,000.00**	Rectangular	5.33	3.33	**2.05**
G		**2.5**	4	5	**50,000.00**	Rectangular	6.67	4.17	**2.56**

Drip irrigation of 1/2 manzana per family

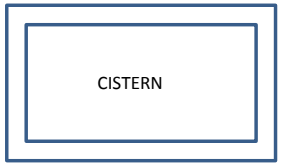
	Excavation						
TYPE	alto	ancho	largo	Vol		5.75 $	
A	**1.5**	2	4	**3.84**		Exc 5,75$	
B	**1.5**	3	4	**5.44**		22.08	
C	**1.5**	4	4	**7.04**		31.28	
D	**2.5**	2	4	**7.68**		40.48	
E	**2.5**	3	4	**10.88**		44.16	
F	**2.5**	4	4	**14.08**		62.56	
G	**2.5**	4	5	**17.6**		80.96	



Corte Longitudinal Cross section

	Wall area											7.5 Juntas de 1 cm		
TYPE	Perimetro	alto	area	Bloques de20	Area piso	Vol de mortero m3	Cem Saco	Arena 90%	Cem 10%	Kg	Bloques 0,5$			
A	6.6	**1.5**	9.9	**123.75**	8.0	0.1056	3/40	0.09504	0.01056	3.19414382	68.06			
B	8.6	**1.5**	12.9	**161.25**	12.0	0.1376	3/52	0.12384	0.01376	2.45131968	88.69			
C	10.6	**1.5**	15.9	**198.75**	16.0	0.1696	3/64	0.15264	0.01696	1.98880653	109.31			
D	8.6	**2.5**	21.5	**268.75**	8.0	0.1376	3/52	0.12384	0.01376	2.45131968	147.81			
E	10.6	**2.5**	26.5	**331.25**	12.0	0.1696	3/64	0.15264	0.01696	1.98880653	182.19			
F	12.6	**2.5**	31.5	**393.75**	16.0	0.2016	2/51	0.18144	0.02016	1.67312295	216.56			
G	12.6	**2.5**	31.5	**393.75**	20.0	0.2016	2/51	0.18144	0.02016	1.67312295	216.56			No lleva tapa

	210 concrete floor														
TYPE	Area piso	Espesor	Vol m3	Sacos cem	Arena m3	Piedra m3	cem *8$*	arena *6 $*	piedra *8$*	Piso	mater $/m3	Costo total $	TIPO		Costo por $/m3
A	8.0	**0.30**	2.40	**17**	1.20	1.680	326.40	17.28	32.26	**471.12**	156.64	561.26	A		46.77
B	12.0	**0.30**	3.60	**25**	1.80	2.520	720.00	38.88	72.58	**706.68**	230.96	826.65	B		45.92
C	16.0	**0.30**	4.80	**34**	2.40	3.360	1305.60	69.12	129.02	**942.24**	313.28	1,092.03	C		45.50
D	8.0	**0.30**	2.40	**17**	1.20	1.680	326.40	17.28	32.26	**471.12**	156.64	663.09	D		33.15
E	12.0	**0.30**	3.60	**25**	1.80	2.520	720.00	38.88	72.58	**706.68**	230.96	951.43	E		31.71
F	16.0	**0.30**	4.80	**34**	2.40	3.360	1305.60	69.12	129.02	**942.24**	313.28	1,239.76	F		30.99
G	20.0	**0.30**	6.00	**42**	3.00	4.200	2016.00	108.00	201.60	**1177.8**	387.60	**1,394.36**	G		27.89
												No lleva tapa	**Prom**		**37.42**
															$



0,20 Block thickness

Plan

M3 mortero juntas horizontales			
0.0132	0.099	0.0066	0.1056
0.0172	0.129	0.0086	0.1376
0.0212	0.159	0.0106	0.1696
0.0172	0.129	0.0086	0.1376
0.0212	0.159	0.0106	0.1696
0.0252	0.189	0.0126	0.2016
0.0252	0.189	0.0126	0.2016

Roof and Cistern System. 3: Costs

Plastic tanks for undergound cisterns

Cap litros	PU Cordobas	PU dolares
1,100.00	3,754.10	**173.00**
1,850.00	6,162.80	**284.00**
2,500.00	7,877.10	**363.00**
5,000.00	17,902.50	**825.00**
10,000.00	35,479.50	**1,635.00**

Drinking water filters

	PU Cordobas	PU dolares
Filtro	325.50	**15.00**
Kit de accesorios	455.70	**21.00**
Accesorios flotante	303.80	**14.00**
Multicontrol	151.90	**7.00**
Tapa	325.50	**15.00**

Mini PCV plastic channels for roofs

Pieza	Ud	PU Cordobas	PU dolares
Canal de 3m	Ud	339.75	15.66
Canal de 4 m	Ud	438.55	20.21
Canal de 6 m	Ud	642.35	29.60
Uniones	Ud	28.90	1.33
Boquillas 4"	Ud	79.90	3.68
Boquillas 3"	Ud	78.75	3.63
Codos90·x4"	Ud	39.15	1.80
Codos90·x3"	Ud	30.10	1.39
Codos 45X4"	Ud	42.10	1.94
Codos 45X3"	Ud	28.75	1.32
Tapas extremos	Ud	17.50	0.81
Esquineros	Ud	40.00	1.84
Bajantes 4"X3m	Ud	256.50	11.82
Bajantes 3"X3m	Ud	150.25	6.92
Pernos y pega	sg	350.00	16.13

		Pu C$	PU$
Sacks of cement	Sack	184.45	8.5
Sand	m3	347.20	16
Gravel m3	m3	672.70	31

Chicken wire 3/4"(rollo de 0,91mx100m)	**toll**	526.61	15.6
Strorm fence	roll		
Malla 1"x1"	roll		

Roll of black plastic (2,44x150 m)	**roll**	6760.00	311.52
Machine excavation	m3		
Preparacion y coloc suelo cemento 3,)	m3		

PVC C26 tubing for drinking water

		PU Cordobas	PU dolares
Tubes	4"	965.20	44.48
	3"	586.00	27.00
	2"	260.00	11.98
	1 1/2"		0.00
	1"		0.00
	1/2"	40.45	1.86
Elbows	4""	148.75	6.85
	3"	116.55	5.37
	2"	17.25	0.79
	1 1/2"		0.00
	1"		0.00
	1/2"	2.70	0.12

EXCAVATED LINED PONDS

Suelo cemento $/m3

60

Length m	Width m	Area m2	Depth m	Volume Excavation m3	Area for lining	with 10 cm earth cement (m3)	5% cem by weight (bags)	m plastic rolls (2,44x150m) (365,76m2)	Cost of mach excav $	Cost lining with 5% earth cement mix	Cost with plastic	Excavation + Earth cement	Excavation+ Plástico	(Cost Excavation+A) $/m3	(Cost Excavation+B) $/m3
										Tipo A	Tipo B	**A**	B		
20.00	10.00	200.00	1.00	**200.00**	260	26	40.00	106.557	1,150.00	1,560.00	331.95	**2,710.00**	**1,481.95**	13.55	7.41
20.00	15.00	300.00	1.00	**300.00**	360	36	55.00	147.541	1,725.00	2,160.00	459.62	**3,885.00**	**2,184.62**	12.95	7.28
20.00	20.00	400.00	1.00	**400.00**	460	46	70.00	188.525	2,300.00	2,760.00	587.29	**5,060.00**	**2,887.29**	12.65	7.22
30.00	10.00	300.00	1.00	**300.00**	360	36	55.00	147.541	1,725.00	2,160.00	459.62	**3,885.00**	**2,184.62**	12.95	7.28
30.00	15.00	450.00	1.00	**450.00**	510	51	78.00	209.016	2,587.50	3,060.00	651.13	**5,647.50**	**3,238.63**	12.55	7.20
30.00	20.00	600.00	1.00	**600.00**	660	66	101.00	270.492	3,450.00	3,960.00	842.64	**7,410.00**	**4,292.64**	12.35	7.15
20.00	10.00	200.00	1.50	**300.00**	260	26	40.00	106.557	1,725.00	1,560.00	331.95	**3,285.00**	**2,056.95**	10.95	6.86
20.00	15.00	300.00	1.50	**450.00**	360	36	55.00	147.541	2,587.50	2,160.00	459.62	**4,747.50**	**3,047.12**	10.55	6.77
20.00	20.00	400.00	1.50	**600.00**	460	46	70.00	188.525	3,450.00	2,760.00	587.29	**6,210.00**	**4,037.29**	10.35	6.73
30.00	10.00	300.00	1.50	**450.00**	360	36	55.00	147.541	2,587.50	2,160.00	459.62	**4,747.50**	**3,047.12**	10.55	6.77
30.00	15.00	450.00	1.50	**675.00**	510	51	78.00	209.016	3,881.25	3,060.00	651.13	**6,941.25**	**4,532.38**	10.28	6.71
30.00	20.00	600.00	1.50	**900.00**	660	66	101.00	270.492	5,175.00	3,960.00	842.64	**9,135.00**	**6,017.64**	10.15	6.69

linear meters

2.077

$/linear meter

Diminishing the depth of earht cement to 5 cm diminished the cost by 50% equaling that of plastic liner

Yields per Use

lts/month

347,250.00

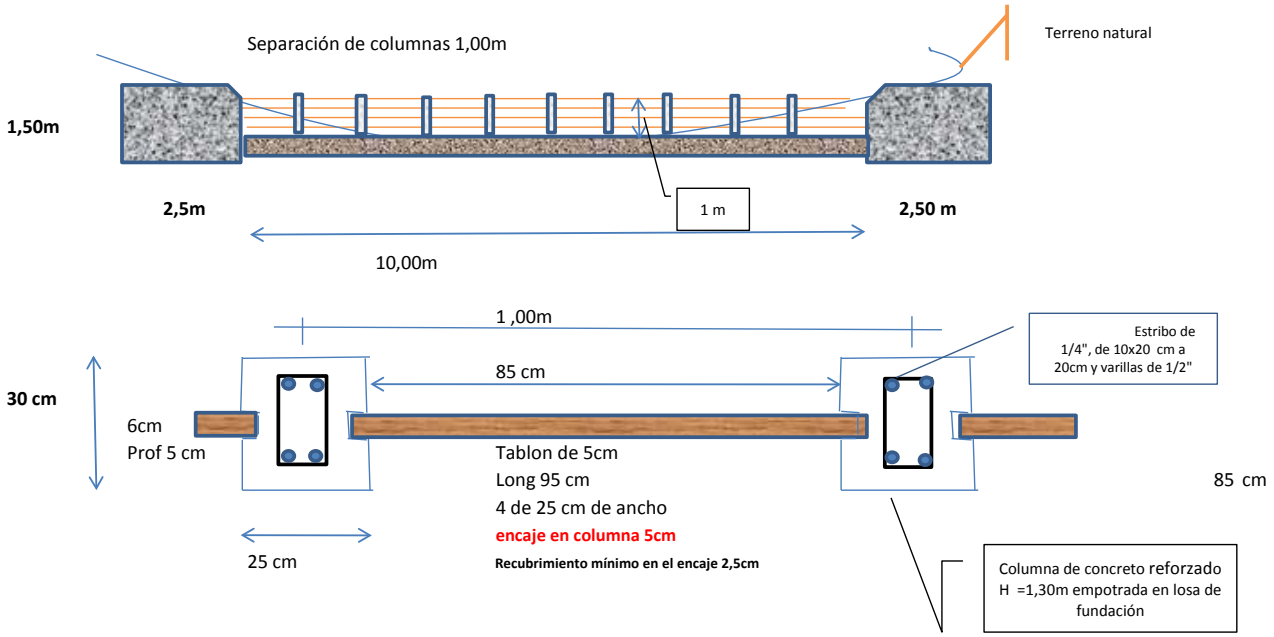
		250 lts/fam/día	**2650 lts/day/0,1 mz**			**0,1 mz**				
		Drinking water	Drip irr.	**mixed use**	Drinking water	Drip irr.	**mixed use**			
Volumn Excavation m3	**Effective liters of water (85%)****	**Months 1 family**	**Months 1 family**	**Months 1 family**	**Families during 2,5 months**			**Cost $/per family DW/m3**	**Cost $/per family DI/m3**	**Cost $/per family mixed/m3**
200.00	170,000.00	22.67	4.28	**0.49**	9	2	**0**	1.51	6.78	
300.00	255,000.00	34.00	6.42	**0.73**	14	3	**0**	0.93	4.32	
400.00	340,000.00	45.33	8.55	**0.98**	18	3	**0**	0.70	4.22	
300.00	255,000.00	34.00	6.42	**0.73**	14	3	**0**	0.93	4.32	
450.00	382,500.00	51.00	9.62	**1.10**	20	4	**0**	0.63	3.14	
600.00	510,000.00	68.00	12.83	**1.47**	27	5	**1**	0.46	2.47	12.35
300.00	255,000.00	34.00	6.42	**0.73**	14	3	**0**	0.78	3.65	
450.00	382,500.00	51.00	9.62	**1.10**	20	4	**0**	0.53	2.64	
600.00	510,000.00	68.00	12.83	**1.47**	27	5	**1**	0.38	2.07	10.35
450.00	382,500.00	51.00	9.62	**1.10**	20	4	**0**	0.53	2.64	
675.00	573,750.00	76.50	14.43	**1.65**	31	6	**1**	0.33	1.71	10.28
900.00	765,000.00	102.00	19.25	**2.20**	41	8	**1**	0.25	1.27	10.15

****15% evaporacion / filtración loss**

Drip irrigation of 1/2 manzana per family

As a drinking water reservoir a sand filter should be built (see Nic 2000 standards) and the water chlorinated in the home

PORTABLE MICRO DAM. 1: Design



Hay que agregar el mecanismo de toma y el largo de tuberias hasta el consumidor

Esto depende del vólumen de agua represado, la capacidad /necesidad del uso(riego)
de la distancia más lejana de utilización , del sistema de riego a usar(goteo, microaspersores, aspesores etc)
a definir en cada caso

Suponiendo similar a Mercedes	**3433.50**	**ml de tuberia principal**	
	76,070.41	**Costo en $**	**22.16 $/ml de tuberia totalmente construida**

PORTABLE MICRO DAM. 2: Details and costs

COMPUTOS MÉTRICOS

				m3
Tablones	**0.05**	**0.25**	**0.85**	**0.010625**
	10	**4**	**0**	**0**

40 piezas de 5cmX25 cm x 85cm de madera de corazón (dura)

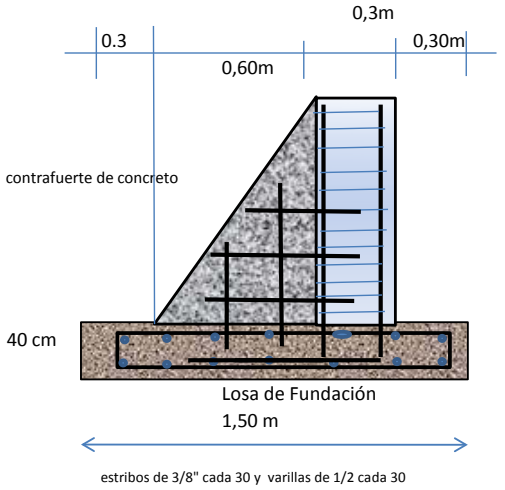
Concretos

	Ancho	Alto	Largo	Vol m3	
Losa de fundación	1.50	0.40	15.00	**9.00**	reforzado
Columnas (11)	0.25	0.30	1.00	**0.83**	reforzado
Contrafuertes (10)	0.60	0.25	1.00	**1.50**	simple
Muros de anclajes (2)	0.60	1.50	2.50	**4.50**	ciclópeo

Acero	Por ud	Diam	Long	log total	**Peso**
Ppal de Columnas	4	1/2"	1.9	**83.6**	**82.76**
Estribos 1/4" (10x20cm	5	**1/4"**	0.7	**38.5**	**8.47**
Contrafuertes		1/2"	6	**60**	**59.40**
					150.63
Losa fundación					
Estribos (1,35x0,28m) @30cr	3	**3/8"**	18.26	**821.7**	**468.37**
Principales	14	**1/2"**	15.00	**210.00**	**207.90**
					676.27
					826.90

Excavaciones	Prof	largo	ancho	Vol m3
Muros anclaje	1.00	2.5	1.00	5.00
losa fundación	0.4	15	1.5	9.00
				14.00

Detalle de columna con contrafuerte



Nota: anclas el contrafuerte con la losa de fundación mediante 3 arranques dobles de altura variable y horizontales hasta la columna varilla de1/2"

PRESUPUESTO REPRESA DESMONTABLE

Descripción	ud	cant	pu$	monto $	C$
Movilizac ión	SG	1.00	900.00	**900.00**	19,530.00
Tranporte de materiales	SG	1.00	1,000.00	**1,000.00**	21,700.00
Desvio y control de aguas	SG	1.00	1,000.00	**1,000.00**	21,700.00
Excavación terreno semiduro	m3	14.00	5.75	**80.50**	1,746.85
Concreto reforzado de 210kgf/cm2	m3	11.33	196.30	**2,223.10**	48,241.22
Concreto ciclópeo 210 y 50% piedra	m3	4.50	134.90	**607.05**	13,172.99
Acero de refuerzo	kg	826.90	2.18	**1,802.65**	39,117.47
Tablones de madera 5X25X85 cm	ud	40	20.00	**800.00**	17,360.00
		Sub total		**8,413.30**	**182,568.52**
		Imprevistos 10%		**841.33**	18,256.85
		Total		**9,254.63**	**200,825.38**

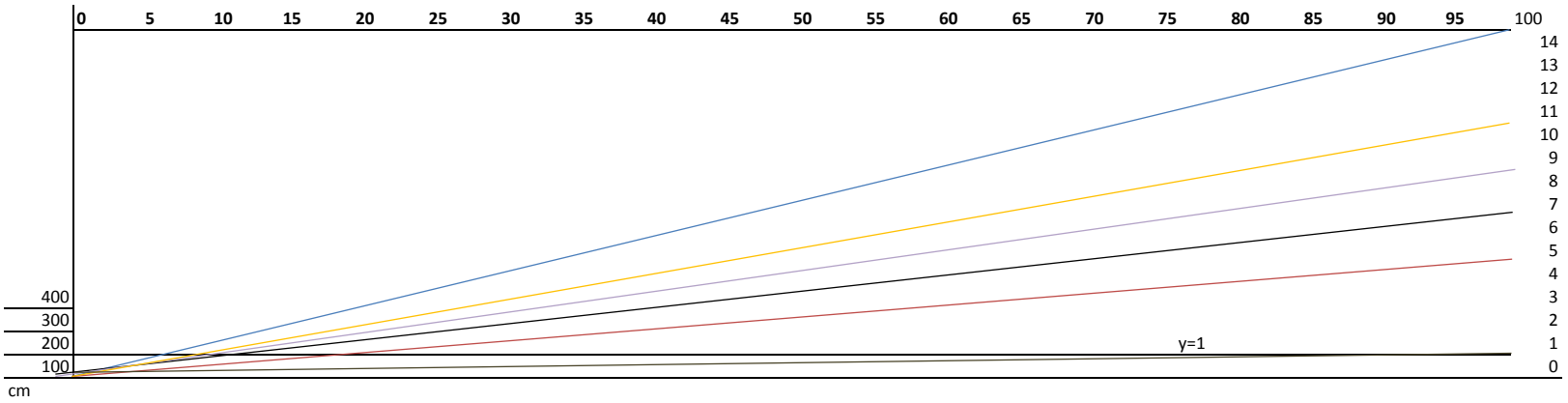
Represa de vaso por área

Costo por m3 máx	**$23.14**	**C$ 502.06**
Costo por m3 min	**$12.34**	**C$ 267.77**

Represa de vaguada de vaso largo

Costo por m3 máx	**277.64**	6024.8
Costo por m3 min	**9.25**	200.8

PORTABLE MICRO DAM. 3: Volumes



x

Y

X	pend	vol	dist
	0	1000	100
100.00	1	900	90
50.00	2	800	80
33.33	3	700	70
25.00	4	600	60
20.00	5	200	20
16.67	6	120	12
14.29	7	100	10
12.50	8	90	9
11.11	9	80	8
10.00	10	60	6
9.09	11	60	7
8.33	12	60	8
7.69	13	60	9
7.14	14	60	10
6.67	15	60	11

Y=a*x+b a=0 Y=b=1

b=0 **a=1/x**

1=x*i/100

X=100/i

Cauce

PEND	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
Largo del vaso	100	50	33	25	20	17	14	13	11	10	9	8.33	7.69	7.14	6.67
VOL m3	**1,000**	**250**	**167**	**125**	**100**	**83**	**71**	**63**	**56**	**50**	**45**	**42**	**38**	**36**	**33**

Se considera un prisma triangular de base 10X1 X Largo , corregido por la pendiente de la vaguada

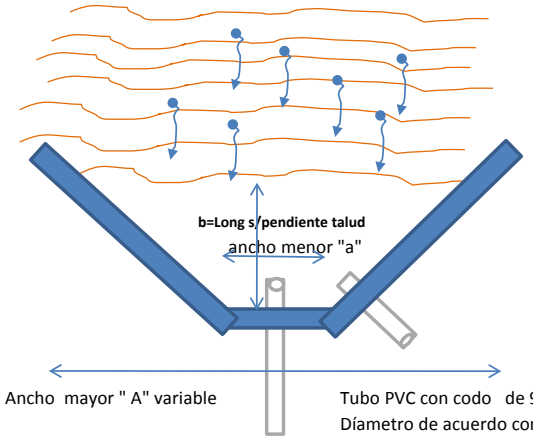
Embalse

Area en Mz	0.014	0.021	0.028	0.035	0.043	0.050	0.057	0.064	0.071	0.078	0.085	0.092	0.099	0.106	0.113
Area vaso m2	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
Factor de pendiente	1.0000	0.5000	0.3333	0.2500	0.2000	0.1667	0.1429	0.1250	0.1111	0.1000	0.0909	0.0833	0.0769	0.0714	0.0667
VOL* m3	**1,000**	**750**	**667**	**625**	**600**	**583**	**571**	**563**	**556**	**550**	**545**	**542**	**538**	**536**	**533**
Vol corregido por pendientes transversales 0,75	**750**	**563**	**500**	**469**	**450**	**438**	**429**	**422**	**417**	**413**	**409**	**406**	**404**	**402**	**400**

***Se considera una Superficie irregular con presa 10X1 X area, corregida por la pendiente longuitudinal de la vaguada**

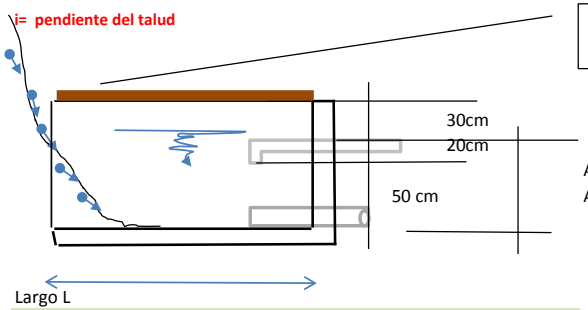
SPRING AND STREAM CAPTURE. 1: Trapezoidal system

no mas de 1000 m de distancia de beneficiarios



Ancho mayor " A" variable

Tubo PVC con codo de 90º
Díametro de acuerdo con caudales



Marco de madera con malla de gallinero de 3/4"

Altura de carga h
Altura total=h+0,30

Largo L

Depende de la pendiente del talud
a mayor pendiente el largo es más aprovechable
la estructura se separa del talud

Capacidad de la toma

							UNA FAMILIA			
							250 lts/fam/día	800 lts/día/mz	19,500.00	
				Caudal min	Caudal requerido	Vol en 24horas	Agua Potable	Riego goteo	uso mixto	familias
A	a	h	Vol m3	llenarse en 12h	l/seg en 1 hora	en litros	Meses	Meses	Meses	beneficiadas
2.00	0.8	0.7	0.98	0.023	0.272	23,520.00	3.14	1.96	**1.21**	1
2.00	0.8	0.7	1.18	0.027	0.327	28,224.00	3.76	2.35	**1.45**	1
2.00	1.20	0.7	1.34	0.031	0.373	32,256.00	4.30	2.69	**1.65**	2
2.00	1.50	0.7	1.47	0.034	0.408	35,280.00	4.70	2.94	**1.81**	2
2.00	0.8	1.00	1.68	0.039	0.467	40,320.00	5.38	3.36	**2.07**	2
2.00	0.8	1.00	1.68	0.039	0.467	40,320.00	5.38	3.36	**2.07**	2
2.00	1.20	1.00	1.92	0.044	0.533	46,080.00	6.14	3.84	**2.36**	2
2.00	1.50	1.00	2.10	0.049	0.583	50,400.00	6.72	4.20	**2.58**	3

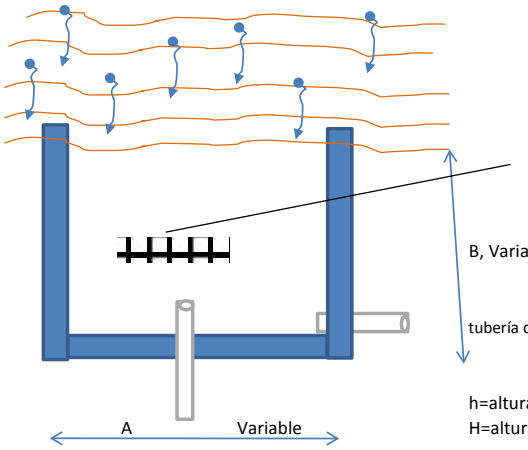
solo una familia máx dos

El caudal del manantial debe ser suficiente para la demanda , diaria y para la hora pico , en finalización del verano

el manantial debe aforarse excavar hueco de 40x40x40cm , secar y medir tiempo en que rebosa n los 64 lts

			UNA FAMILIA				
			250 lts/fam/día	800 lts/día/mz	19,500.00	1,2 meses	2 meses
AFORO			Cons Agua Potable	Riego goteo	uso mixto	Familias	solo con agua
Seg	l/seg	litros diarios	Meses	Meses	Meses	beneficiadas	potable
10	**6.40**	619,520.00	82.60	51.63	**31.77**	**26**	**41**
20	**3.20**	309,760.00	41.30	25.81	**15.89**	**13**	**21**
30	**2.13**	206,506.67	27.53	17.21	**10.59**	**9**	**14**
40	**1.60**	154,880.00	20.65	12.91	**7.94**	**7**	**10**
50	**1.28**	123,904.00	16.52	10.33	**6.35**	**5**	**8**
60	1.07	103,253.33	13.77	8.60	**5.30**	**4**	**7**
70	0.91	88,502.86	11.80	7.38	**4.54**	**4**	**6**
80	0.80	77,440.00	10.33	6.45	**3.97**	**3**	**5**
90	0.71	68,835.56	9.18	5.74	**3.53**	**3**	**5**
100	0.64	61,952.00	8.26	5.16	**3.18**	**3**	**4**
110	0.58	56,320.00	7.51	4.69	**2.89**	**2**	**4**
120	0.53	51,626.67	6.88	4.30	**2.65**	**2**	**3**

SPRING AND STREAM CAPTURE. 2: Box system for steep slopes.



h=altura de carga
H=altura de carga+0,30

El piso piede ser de bloques de concreto o concreto

								UNA FAMILIA			
								250 lts/fam/día	800 lts/día/mz	19,500.00	
				Capacidad	Caudal min	Caudal requerido	Vol en 24horas	Cons Agua Potable	Riego goteo	uso mixto	familias
A	B	h	m3	litros	llenarse en 12h	l/seg en 1 hora	en litros	Meses	Meses	Meses	beneficiadas
2.00	2.00	0.70	2.80	2,800	0.065	0.778	67,200.00	8.96	5.60	**3.45**	**3**
2.00	2.00	0.80	3.20	3,200	0.074	0.889	76,800.00	10.24	6.40	**3.94**	**4**
2.00	2.00	0.90	3.60	3,600	0.083	1.000	86,400.00	11.52	7.20	**4.43**	**4**
2.00	2.00	1.00	4.00	4,000	0.093	1.111	96,000.00	12.80	8.00	**4.92**	**5**
4.00	2.00	0.70	5.60	5,600	0.130	1.556	134,400.00	17.92	11.20	**6.89**	**7**
4.00	2.00	0.80	6.40	6,400	0.148	1.778	153,600.00	20.48	12.80	**7.88**	**8**
4.00	2.00	0.90	7.20	7,200	0.167	2.000	172,800.00	23.04	14.40	**8.86**	**9**
4.00	2.00	1.00	8.00	8,000	0.185	2.222	192,000.00	25.60	16.00	**9.85**	**10**
6.00	2.00	0.70	8.40	8,400	0.194	2.333	201,600.00	26.88	16.80	**10.34**	**10**
6.00	2.00	0.80	9.60	9,600	0.222	2.667	230,400.00	30.72	19.20	**11.82**	**12**
6.00	2.00	0.90	10.80	10,800	0.250	3.000	259,200.00	34.56	21.60	**13.29**	**13**
6.00	2.00	1.00	12.00	12,000	0.278	3.333	288,000.00	38.40	24.00	**14.77**	**15**

Volumenes de agua en tuberías

Diam pulg	mm	m3/m	litros/m	litros en 1000 m
4	**101.6**	0.0081	8.1125	8,112
3	**76.2**	0.0046	4.5633	4,563
2	**50.8**	0.0020	2.0281	2,028
2 1/2	**63.5**	0.0032	3.1689	3,169
2	**50.8**	0.0020	2.0281	2,028
1 1/2	**38.1**	0.0011	1.1408	1,141
1	**25.4**	0.0005	0.5070	507
3/4	**19.05**	0.0003	0.2852	285
1/2	**12.7**	0.0001	0.1268	127

Ejemplo de Calculo del agua en la red

		long s/diam	
Diam pulg	mm	m	litros
4	**101.6**	200	1622
3	**76.2**	150	684
2	**50.8**	300	608
2 1/2	**63.5**		
2	**50.8**		
1 1/2	**38.1**	300	342
1	**25.4**	250	127
3/4	**19.05**		
1/2	**12.7**	350	44
		1550	**3429**

ANNEX 3

Preparatory Study and Final Design of Las Mercedes Irrigation System

Technical Specifications

Project Name:	Las Mercedes Irrigation Project
Political Location:	Las Mercedes Region, El Sauce Municipality, Department of Leon
Geographical Location:	86° 28' to 86° 30' Longitude West and 12° 50' Latitude North
Target Group:	65 Families from Central Mercedes and Cooperative Ismael Castillo
Area that can be irrigated by Project:	100 mzs (0,7 Ha)
Incremental Flow Irrigation Area:	116 mzs (0,7 Ha)
Project Objective:	Improve livelihoods for several families that live in the proximity of Mercedes River by improving conditions for agricultural production.
Specific Objectives:	▪ Sign agreements for water use among user groups located along Mercedes River. ▪ Increase the number of farmers with irrigation and increase family revenues by improving water availability for agricultural production under irrigation by building irrigation infrastructure. ▪ Improve agricultural production and productivity to increase produce availability for consumption and trade in the market. ▪ Increase exploitation of the water available in Mercedes River to guarantee harvests during the rainy season and production during the dry season.
Beneficiaries	65 families
Goals:	▪ Implement a sprinkler irrigation system in the Central Mercedes Area. ▪ Improve the surface irrigation system in the Cooperative. ▪ Guarantee water supply in the water trough for stockbreeders.
Promoting Entity:	Millennium Challenge Account
Entities Involved:	Mercedes Irrigators' Association (ARME for its acronym in Spanish), El Sauce Municipality
Implementation Period:	▪ Civil Works: 160 calendar days ▪ Post-Construction Accompaniment Services: 10 months
Investment Cost:	▪ Civil Works: 256.962,43 USD

Design Process

Background

The Millennium Challenge Account Nicaragua Program is developing its actions in three components: road infrastructure improvement, property rights intensification and rural business development. The general objective of the latter component is to increase value added rural business in Leon and Chinandega to attain rural economic reactivation in the West by generating ample social and environmental benefits that contribute to poverty reduction and preservation of natural resources.

In October 1998, before Hurricane Mitch, the Ministry of Agriculture and Forestry (MAGFOR for its acronym in Spanish), prepared the National Irrigation Program for small and medium-sized farmers aimed at developing small irrigation systems within a 10 year period, including the necessary capture and storage works.

The endeavor was to raise the technological level and capabilities of small and medium farmers in managing irrigation systems, reduce production risks by increasing crop productivity and profitability, increase jobs in rural areas and reduce migrations from the countryside to the city. However, Hurricane Mitch struck Nicaragua causing intense rainfall historically unprecedented, affecting the Pacific region, although much stronger in the north (Chinandega and León) and the North Central region (Estelí, Nueva Segovia, Jinotega and Matagalpa).

As of this environmental disaster, the western area of the country has tried to restore agricultural production, for which the MCA-Nicaragua commissioned a study to develop an "Action Plan for Watershed Management and Land Development, and Comprehensive Use of Priority Sub-Basins in the Departments of Leon and Chinandega" in order to support small and medium farmers in their efforts to increase sustainable use of surface waters.

The plan's objective was to gather and process socioeconomic and biophysical information in the region's seven watersheds, to identify critical areas and recommend investment projects, at the profile level, in three priority sub-basins that can be economically feasible, environmentally friendly and socially sustainable.

The action plan for the priority sub-basins concluded in December 2007 and initially identified 16 potential sites for development of irrigation infrastructure in priority sub-basins; once the preliminary feasibility studies were carried out, among these, the following turned out to be a priority:

a) Chiquito River micro-basin catchment area located in Achuapa Municipality.

b) Las Mercedes River micro-basin water inlet in El Sauce Municipality.

c) Salale River micro-basin water inlet in El Sauce Municipality.

The three identified micro-basins belong to the Rio Grande sub-basin, which in turn tributes into the Great Basin of the Estero Real (estuarine), which is well-known for its vast economic importance and environmental vulnerability in the Western Region of the country.

On this basis, and particularly considering the timing process to evaluate the feasibility and eventual performance of the proposed works, an *Addendum* is required to the current contract with the consulting firm that prepared the watershed plan so that they can complete specific studies for better use of their expanded knowledge of the region, the elaborated proposals and their expertise on the topic addressed.

The Addendum to the GFA Contract was signed on March 4, 2008 for elaboration of the "Pre-investment Studies (economic, environmental and social feasibility) and the Final Design of the Two Water Inlets for Irrigation located in: 1) Las Mercedes River; 2) Salale River, and the Pre-Investment Study (economic, environmental and social feasibility) for a Reservoir Located on Chiquito River". This report corresponds to the Final Design for Mercedes Irrigation Project.

Participatory Process for Project Conceptualization

Participatory Design Phase

The Mercedes Irrigation Project Design was jointly executed with future beneficiaries, with the purpose of not only recognizing the situation and current issues in the use of irrigation water, but also to identify, recognize and incorporate local capacities in the design, which would set the basis for systems of a collective nature to be operated and maintained by the users themselves.

The participatory design process applied different techniques and work methods grouped in the well-known Participatory Diagnosis, which can be organized into phases that harmonize with those applied by the Millennium Challenge Account for public consultation processes.

PHASE 1: Coordination and work with institutions and representatives of the beneficiary regions to gather basic information for the projects.

PHASE 2: Validation, consultation and joint work with beneficiary regions and future users of the irrigation systems in the conceptual design of the prospective irrigation system.

PHASE 3: Project presentation to the Municipality or Open Consultation phase.

Gender Approach in the Participatory Design

Special emphasis was placed on gender issues during the execution process, which considered four aspects in the irrigation projects with a well-known connotation about

gender issues: 1) access to water, 2) participation in decision-making processes, 3) technology selection, and 4) crop selection and division of labor.

1) Access to Water

According to Nicaraguan regulations, the right to usufruct water is directly linked to land ownership; therefore, irrigation systems for formal water distribution follow the pattern pertaining to ownership of plots.

The Consultant was particularly careful in identifying and registering women as partners of the irrigation systems, recognizing them as owners of their own plots (even within the family sphere); updated records for the final design evidence that 20% of direct project beneficiaries are women.

2) Participation in Decision-Making Processes to Operate the Irrigation System

There are two main spheres of participation in irrigation systems: on the Board of Directors of the Irrigators' Association and in the Assembly of Members. The Consultant fostered women's participation on the Boards of Directors to be established. Effectively, farmer women were already participating in each steering committee, which also relied on the participation of a woman engineer from El Sauce Town Hall. Female participation reached 50% on the Steering Committee and 40% on the Board of Directors of the Association.

Moreover, women are encouraged to actively participate in meetings during the final design phase in order to incorporate specific requirements into the infrastructure design and to define future system operations. GFA Consulting always explicitly invited men and women to participate in the meetings held. Women's attendance to the total of meetings held reached 37%.

3) Water Uses and Technology Selection

A specific activity was carried out with women to elaborate an inventory of the demands for water usage, aside from agriculture, in order to incorporate designs for specific facilities to provide water for other uses (water troughs, Laundromats). Results are evident in that the project includes water supply to Laundromats for women members of the Ismael Castillo Cooperative and from Los Almendros during shortage periods.

On the other hand, artifact designs of proven convenience in their use were incorporated, also for use by women (12" diameter sprinklers).

4) Crop Selection and Division of Labor

Decisions on production are the exclusive responsibility of families that participate in each irrigation system. Systems designs guaranteed water distribution to allow cultivation of even the most demanding crops in terms of water consumption, which avoids restrictions on selection. As a result, there are no obstacles for crops specifically preferred by women.

Final design of irrigation projects is not directly related to other agricultural production issues per se, precisely because the water distribution scheme grants absolute freedom in crop selection to participating families. Therefore, gender related aspects in relation to division of labor in specific crops and/or dominant produce /income among men and women are not within the area of competence of the Consultant in the final design phase, but are rather linked to future business plans to be elaborated at the individual farm level.

Design Process Phases

The initial work phase involved contacts with El Sauce Municipality to explain the objectives and work methods to be executed, as well as to plan revenues for beneficiary regions.

With support from technical experts designated by the municipalities, leaders in beneficiary regions were contacted, with whom field tours were made to identify and record on aerial photographs, parcels located within the project's area of influence as well as the names of the owners.

During execution of the field work, special emphasis was given to identification of conflicts arising from the use of water along the course of water resources, for which regions were visited, including the administrative centers and the end of the basin.

During this phase, technical fieldwork involved hydrology studies to determine available water offer throughout different months, the areas and crop periods, initial topographic works and the volume of flow capacities. Execution in the production area performed crop surveys that determine crop schedules as well as updated production costs for current crops.

The outcome for this phase was a diagnosis that characterizes the project area, identifying issues and potential water use in the micro-basin, as well as the necessary basic information to design the works. As a result of the diagnosis, different alternatives were identified and proposed to solve issues in water use revealed during the study.

Within the project framework, the most important outcome during this phase was the elaboration of the Pre-Feasibility Study for the Las Mercedes Irrigation Project.

The second work phase, with the projects' beneficiary population, began with the presentation of the diagnosis in area and general meetings to validate the information and submit the project alternatives to the consideration of the beneficiaries.

During this phase, three different meetings were held to present and analyze different design alternatives as well as for operation and water distribution in the prospective system. Registration of people's attendance by sex also began in order to monitor beneficiary participation.

The most important outcomes during this phase include: creation of the Project Committee, survey of updated and corrected lists of future beneficiaries, specific

meetings with groups of women to determine the degrees of participation in productive tasks and specific water use requirements.

The most important outcomes during this phase were: creation of Las Mercedes Irrigators' Association, approval of the basic rules to operate the prospective irrigation systems and elaboration of the final design.

The final phase, according to the MCA scheme, corresponded to the public project consultation. In the case of projects, as part of the final work phase, the following activities were carried out:

- Submission of the request to incorporate the "Registry of Residents' Associations and Sector Organizations" of El Sauce Municipality.
- Submission of the Final Las Mercedes Project Design to the authorities of El Sauce Municipality in order to obtain authorization for construction and the environmental permit.

Both actions are deemed as open consultation activities before the municipality and the outcomes were registration of the Association and approval of the requested authorizations.

Technical Design Process

The methodology used by the GFA Consultant contemplates a participatory process with vast interaction among beneficiaries and technical experts to formulate the project.

During the feasibility study, together with the beneficiaries and technical team from El Sauce Municipality, the main limitations for better exploitation of water resources in the area were recognized, such as water exploitation along Mercedes River, both for crop irrigation and for other uses. Finally, the expectations of the users in relation to the project were established.

These assessments led to a study of alternatives to first create a hydraulic scheme that responds to requirements, and secondly, to assess the type of infrastructure in accordance with the proposed scheme. Chapter 6 of the feasibility study contains the detailed analysis of the possible alternatives found during the feasibility study carried out between the months of March to June 2008.

Following is a summary of said analysis, being the characteristics of the area:

- Four groups of users that compete for Las Mercedes River flow; this competition for the resource basically occurs during the peak low water levels in the river.
- The first group in the Borbollón Sector extracts a low flow and expectations of increased area are very limited due to the topography of the terrain; for this reason, the agreements concentrated on exploitation with the three remaining groups. The second group, located in the middle area of the river, relies on experience with sprinkler irrigation and presents plots with high to moderate slopes. The third group is

integrated by farmer members of the former Cooperative Ismael Castillo; in this sector, plots of land are flat and uniform while also relying on experience with surface irrigation. Finally, a fourth group that although they are not farmers, they demand water for their livestock.

- In addition to use for irrigation and livestock consumption, requests have been identified by ladies that on the one hand, request connection of the existing cooperative's Laundromats to the pressure systems of Central Mercedes (second group), and on the other hand, construction of new Laundromats in the lower area of the river for the wives of stockbreeders.

The following was established as the hydraulic exploitation scheme:

- During the low period, Mercedes River relies on two main tributaries, which are in turn fed by springs in the Borbollón area. Considering that both tributaries rely on similar volumes of flow, the proposal is that the second group (Central Mercedes) exploits the water of the right affluent (Antonio Springs) and the cooperative group exploits the waters of the left affluent (Pablo Springs).
- The Central Mercedes group will irrigate with sprinklers, recognizing old and new users. During the drier period in the river, only old users will be able to irrigate; during the remaining months, all of the partners will be able to irrigate with sprinklers.
- Irrigators from the cooperative will be able to irrigate with surface irrigation using a shift system, having to reduce the irrigated area during the months with lower volumes of flow in the river.
- Stockbreeders located in the low part will receive a water shift for storage in a pond during the minimum volumes of river flow.
- Due to low volumes required for doing the laundry, a connection to the cooperative's Laundromats and the Central Mercedes system is proposed. For Laundromats on the lower part, the proposal is to reserve part of the flow stored in the pond for this purpose.

The feasibility analysis of the infrastructure sets forth:

- Build an inlet on the right affluent for the Central Mercedes system.
- Build a network of PVC pressure pipes to then deliver water to plots from hydrants.
- The irrigation perimeter of the pressurized network includes different parcels located on both banks of Mercedes River.
- The cooperative relied on a river inlet, which Hurricane Mitch damaged in 1998; it is hereby proposed to rehabilitate and improve it.
- Because the first channel sections suffer the greatest loss of water, we propose to line the main canals and to build distributors and motor vehicle ducts.
- To guarantee high levels of water availability for stockbreeders, who will gradually take their herds to the water hole, we propose building a pond and concrete troughs.

- Finally, for the laundry in the lower part of the river, we propose building a Cyclops concrete floor and installation of commercial Laundromat that will be connected to the pond.

The hydraulic scheme, such as the required infrastructure was discussed with the Millennium Challenge Account technical experts and with the project's steering committee. Once the basis for the design was agreed, during the final design period, topographic works were completed and calculations of the hydraulic system were performed, as well as the design for a proposal for joint operation of the works.

Parallel to the design process, both the ability to access through private properties where works are located or that will serve for construction of access routes for provisioning materials were evaluated.

After determining the volumes and quantities of works required, costs were elaborated and budgets were formulated; also construction plans, technical specifications and construction schedules. Budgets for works were divided between contributions from the financial institution that will be used to pay the contractor, and the contribution from beneficiaries will be used for labor, in the excavation and forming of channels, trenching works for the pipes and steam rolled filling for ditches and canals (exterior).

Each stage of the technical design was discussed with the farmers, to assess the complexity of operations, project size, types of materials and construction time.

Executive Summary of Basic Studies

Agricultural /Livestock Production in the Area

Las Mercedes Irrigation Project is located in Las Mercedes Region, which belongs to El Sauce Municipality in the Department of Leon. It is geographically located on the coordinates 86° 28' to 86° 30' Longitude West and 12° 50' Latitude North. The irrigation area has an altitude between 205 and 360 meters above sea level (refer to Figure 1).

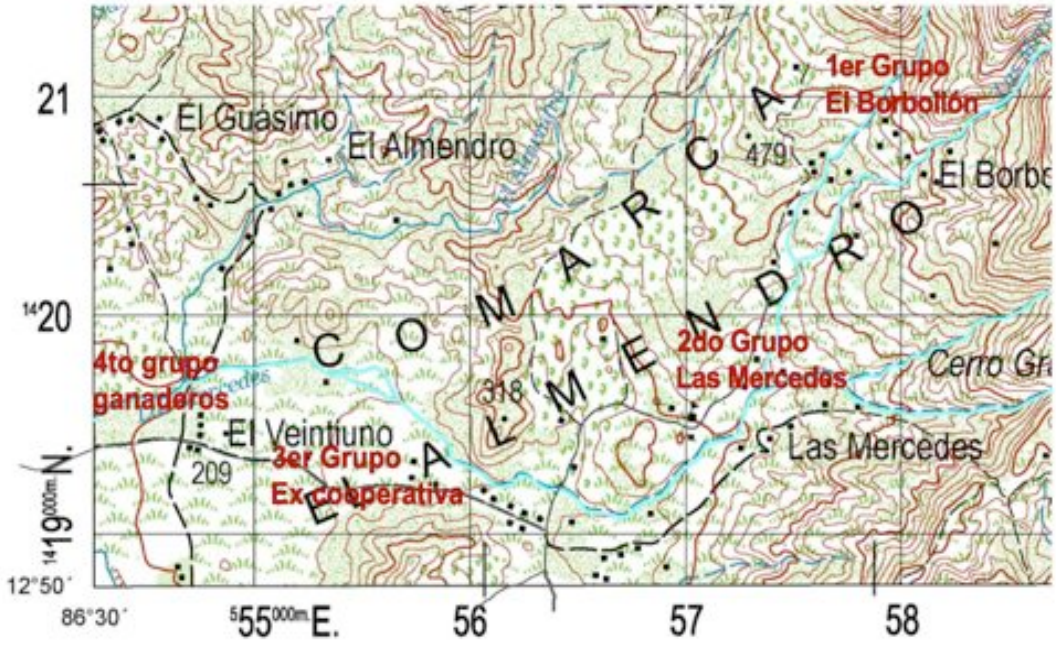


Figure 1: Project Location

The project's area of influence is located to the southeast of El Sauce's population and it is accessed on an 11 kilometer dirt road in regular condition, which involves an approximately 20 minute ride.

The Mercedes Irrigation Project benefits part of the population living in Central Mercedes hamlets and the Ismael Castillo Cooperative, encompassing a cultivable area of approximately 100 mzs.

Current Agricultural Production

As in the rest of the Nicaraguan territory, two crop seasons are clearly distinguished in Mercedes: during the rainy season, the "first" or winter sowing season, which takes place between the months of May and July before incidence of the "Indian Summer", and the "last" sowing season, which takes place between the months of September and November, once the Indian Summer has passed.

The Indian summer is an atmospheric phenomenon characterized by a dry period of about 20 to 30 days without rainfall in the midst of the rainy season. Normally, it occurs between the months of July and August, constituting the main limitation or source of risks for the "first" crop period.

First Crop Period

The "first" crop period involves higher levels of risk for farmers due to its dependence on the winter rains. Its success or failure is very dependent on delays or regularity of

initial rains during the month of May. Any delay of the rain will consequently imply that crops will be affected by the “Indian Summer” at the end of their development periods.

An additional risk for the “first” crop period is the possible occurrence of Saint John’s warm spell at the end of the month of June, where the lack of rains may damage crop growth. In low lands with bad surface drainage, the risk of flooding due to excess water in light of high intensity rainfall events must be added.

Due to the above described climate factors, farmers from Las Mercedes prefer to cultivate reduced areas and almost exclusively with maize growing, sometimes in association with sorghum or corn.

The characteristics of the crop period also define whether or not agricultural production will be aimed almost specifically for internal farm consumption as food reserves and eventual seeds.

Last Crop Period

In terms of crop area, the last crop period is the most important crop period due to the fact that climate risks reduce to a minimum, so harvests are safe and can be intended both for internal consumption and trade or exchange of products.

In Central Mercedes, during this period – in addition to maize cultivation – there are significant bean cultivation areas, the product of which is mostly intended for trade in the market. In the Cooperative sector, there are crop areas with maize and bean, in addition to areas used for pineapple and sugarcane cultivation.

Summer Crop Period, Under Irrigation

The crop period under irrigation encompasses the months of November to the beginning of the month of May, which is characterized by an almost total absence of rain in the sector; therefore, agricultural production is only possible under irrigation.

Production under irrigation in the Central Mercedes sector preserves maize and bean as important crops complemented with small areas for other crops such as a certain type of squash and sweet pepper that do not even reach a manzana. In the Cooperative sector, in addition to the traditional crops of maize and bean, pineapple and sugarcane, there are squash and sesame produce.

Due to conflicts in the use of water – depending on its availability in the entire sector – there are reduced crop areas, especially in the Cooperative sector where it was confirmed that during the current period, from February to April, only 12,5 manzanas were cultivated.

Crop Cards

With the information gathered in the field, crop cards were created for the situation without a project, taking into account the prospective irrigation area, the results of which appear in a differentiated manner for Central Mercedes and the Cooperative. The crop cards evidence crop periods and crop areas by crops in a specific area, and may be

presented by consigning physical areas expressed in a surface unit or as a percentage of the area in relation to a reference.

The reference is the total area that could be irrigated in the future (prospective irrigation perimeter), although they also show as an example, the fractions obtained if the area currently under irrigation is taken as a reference (current irrigation perimeter).

The information extracted from the card is the monthly cultivated area and annual cultivated area, which according to production intensity or number of harvests in a plot may be higher to the physical area of reference, defined by the irrigation perimeter.

Crop Cards for Central Mercedes

Table 1 shows the crop cards for the current situation – without a project – for the Central Mercedes sector.

Table 1: Crop Cards for Central Mercedes (Areas in Mzs)

CROP	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	TA	*f* TA
Bean R1	8,0										8,0	8,0	8,0	0,16
Bean R2		4,0	4,0	4,0									4,0	0,08
Bean Last									18,0	18,0	18,0		18,0	0,36
Maize R1										6,0	6,0	6,0	6,0	0,12
Maize R2	7,0	7,0	7,0										7,0	0,14
Corn										2,0	2,0	2,0	2,0	0,04
Maize First					20,0	20,0	20,0						20,0	0,40
Maize Last									12,0	12,0	12,0		12,0	0,24
TOTAL:	15,0	11,0	11,0	4,0	20,0	20,0	20,0	0,0	30,0	38,0	46,0	16,0	77,0	**1,54**

Notes:
Current Irrigation Perimeter: 18,5 Mzs (12,6 Ha).
Prospective Perimeter (Total Area): 50 Mzs (41,3 Ha).
R1 and R2: Areas under irrigation (R2 corresponds to critical season)
TOTAL: Total cultivated area per month
TA: Total area per crop
f TA: Fraction of the cultivated area in the prospective perimeter

Source: Pre-Investment Study

Considering crops cultivated throughout the year, an intensive use of 1,54 is evident, which implies a total cultivated area of 77 manzanas in a physical area of 50 manzanas. The monthly analysis of the crop areas confirm intensive use of the plots during the "last" crop period, with almost the entire area cultivated during the months of September and October.

Table 2 shows the current crop card for the Cooperative's irrigation system; it shows that – like in Central Mercedes – the period with more cultivated area corresponds to the "last" period, with 33 manzanas. One special characteristic of the Cooperative's system is the area cultivated with pineapple and sugarcane, which occupy the plots throughout the entire year. If annual land use is considered, we find an intensity of 1,19.

Table 2: Crop Card for the Cooperative, Areas in Mzs

CROP	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	TA	*f* TA
Bean "Last"									11,0	11,0	11,0		11,0	0,22
Bean R2	2,0	2,0										2,0	2,0	0,04
Maize First					15,0	15,0	15,0						15,0	0,30
Maize "Last"								15,0	15,0	15,0			15,0	0,30
Maize R1	2,0										2,0	2,0	2,0	0,04
Maize R2		2,0	2,0	2,0									2,0	0,04
Sesame	2,0										2,0	2,0	2,0	0,04
Pineapple	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	0,10
Sugarcane	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	0,04
Squash		3,5	3,5	3,5									3,5	0,07
TOTAL:	13,0	14,5	12,5	12,5	22,0	22,0	22,0	22,0	33,0	33,0	22,0	13,0	59,5	**1,19**

Notes:
Current Irrigation Perimeter: 35 Ms (24,5 Ha).
Prospective Perimeter (Total Area): 50 Mzs (35 Ha).
R1 and R2: Areas under irrigation (R2 corresponds to the critical season)
TOTAL: Total cultivated area per month
TA: Total area per crop
f TA: Fraction of the cultivated area in the prospective perimeter

Source: Pre-Investment Study

Agricultural Production with the Project

With the purpose of assessing the productive potential under irrigation, two prospective productive scenarios have been elaborated: one applied to the Central Mercedes sector in which traditional crops (maize and bean) are still predominant in terms of areas and crop periods; and a second scenario, applied to the Cooperative, which gathers the variety of crops currently cultivated plus the introduction of some crops that are more profitable than the traditional ones.

Traditional Scenario in Central Mercedes

The first productive scenario keeps the current productive structure, slightly boosting more profitable crops: bean, maize, corn and small areas with sweet pepper and/or tomato. Table 3 shows the crop card corresponding to the improved traditional scenario.

Table 3: Crop Card for the Central Mercedes Scenario, Area in Mzs

CROP	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	TA	*f* TA
Bean First					10,0	10,0	10,0						10,0	0,200
Bean R1	12,0										12,0	12,0	12,0	0,240
Bean R2		4,0	4,0	4,0									4,0	0,080
Bean "Last"								18,0	18,0	18,0			18,0	0,360
Tomato									2,0	2,0	2,0	2,0	2,0	0,040
Sweet Pepper	2,0	2,0	2,0									2,0	2,0	0,040
Maize R1										12,0	12,0	12,0	12,0	0,240
Maize R2	7,0	7,0	7,0										7,0	0,140
Maize Corn										6,0	6,0	6,0	6,0	0,120
Maize First					20,0	20,0	20,0						20,0	0,400
Maize "Last"								12,0	12,0	12,0			12,0	0,240
TOTAL:	21,0	13,0	13,0	4,0	30,0	30,0	30,0	30,0	32,0	50,0	32,0	34,0	105,0	**2,100**

Notes:
Prospective Perimeter: 50 Mzs
R1: Areas under irrigation during initial low water flow season
R2: Areas under irrigation during critical periods
TOTAL: Total cultivated area per month
AT: Área total por cultivo.
f AT: Porcentaje de área cultivada por perímetro futuro, en fracción.

Source: Pre-Investment Study

The card for the improved traditional scenario shows that during the "first" and "last" crop periods, maize and bean maintain their importance with 32 and 28 manzanas respectively, for a total 60 manzanas.

The irrigation period shows a significant increase, especially during the first period between October and February, with 32 manzanas and decreases to 13 manzanas during the critical months from February to April.

Considering all crops, land use is very intensive due to the fact that 105 manzanas of crops over a 50 manzana perimeter represent a factor of 2,10, which evidences a capacity for two annual harvests with irrigation.

Diversified Scenario in the Cooperative

The second productive scenario, proposed for the Cooperative's sector, takes into consideration diversification of the current production by introducing some profitable crops intended for the market and also includes irrigation of traditional "first" and "last" maize and bean cultivation in the new area.

The second scenario shows productive use of water and land resources by cultivating pineapple and squash, but also considers introduction of other crops such as tomatoes and sweet pepper. The crop card for this proposed second scenario appears on Table 4.

Information on Table 4 shows increased areas in traditional crops as a result of the expanded irrigation area by 15 manzanas, which could not be irrigated during the critical period. Traditional crops cover an area of 75 manzanas.

Table 4: Crop Card for the Diversified Scenario, Area in Mzs

CROP	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	TA	*f* TA
Bean "Last"									20,0	20,0	20,0		20,0	0,40
Bean R1	4,0	4,0										4,0	4,0	0,08
Maize "First"					25,0	25,0	25,0						25,0	0,50
Maize "Last"								20,0	20,0	20,0			20,0	0,40
Maize R1	4,0	4,0									4,0	4,0	4,0	0,08
Maize R2		2,0	2,0	2,0									2,0	0,04
Tomato R1	4,0										4,0	4,0	4,0	0,08
S. Pepper R1	2,0									2,0	2,0	2,0	2,0	0,04
Sesame	4,0										4,0	4,0	4,0	0,08
Pineapple	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	0,12
Sugarcane	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	0,04
Squash R2	5,0	5,0	5,0										5,0	0,10
TOTAL:	31,0	23,0	15,0	10,0	33,0	33,0	33,0	28,0	48,0	50,0	42,0	26,0	98,0	**1,96**

Notes:
Prospective Perimeter: 50 Mzs
R1: Areas under irrigation during initial low water flow season
R2: Areas under irrigation during critical periods
TOTAL: Total cultivated area per month
AT: Área total por cultivo.
f AT: Porcentaje de área cultivada por perímetro futuro, en fracción.

Source: Pre-Investment Study

During the irrigation period, a significant increase is evident during the first period of drought, from 13 to 26 manzanas, but the area under irrigation does not increase during the critical period, when it is anticipated that water will be shared with the stockbreeders.

In annual terms, in this scenario, the proposal is to cultivate 98 manzanas throughout the year with the introduction of more profitable crops.

In summary, it is obvious that occupation of the plot is important throughout traditional crop cultivation, between 33 and 48 manzanas, very important, 26 manzanas during the first irrigation period, and dropping to 10 manzanas during the critical month of April.

Changes in Agricultural Production

Implementation of the irrigation project will not only allow expansion of the physical area for crops under irrigation, from the current 53 manzanas to 100 manzanas with the project, but will also have other effects, among which the following can be expected: increased cultivation area during different crop periods and increased crop yields by reliance on water, guaranteed throughout the entire year.

Increased Cultivated Area

Table 5 shows a summary of the changes in terms of cultivated areas, during different crop periods, anticipated in the two proposed alternative scenarios. In terms of total cultivated areas, it can be observed that the new scenarios propose an increase in the annual cultivated area from the current 203 manzanas that correspond to the increased cultivation intensity of 1,37 to an average of 2,03.

Table 5: Anticipated Changes in the Cultivated Areas, in Mzs

		MERCEDES WITH		MERCEDES WITHOUT		COOPERATIVE WITHOUT		COOPERATIVE WITH	
CULTIVATION	CROP	Area	%	Area	%	Area	%	Area	%
First	Bean	0,00	0,00	10,00	0,20	0,00	0,00	0,00	0,00
	Maize	20,00	0,40	20,00	0,40	15,00	0,43	25,00	0,50
	Annually	0,00	0,00	0,00	0,00	7,00	0,20	8,00	0,16
	Others	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		20,00	0,40	30,00	0,60	22,00	0,63	33,00	0,66
Last	Bean	18,00	0,36	18,00	0,36	11,00	0,31	20,00	0,40
	Maize	12,00	0,24	12,00	0,24	15,00	0,43	20,00	0,40
	Annually	0,00	0,00	0,00	0,00	7,00	0,20	8,00	0,16
	Others	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		30,00	0,60	30,00	0,60	33,00	0,94	48,00	0,96
Irrigation	Bean	8,00	0,16	12,00	0,24	2,00	0,06	4,00	0,08
	Maize	8,00	0,16	18,00	0,36	2,00	0,06	4,00	0,08
	Annually	0,00	0,00	0,00	0,00	7,00	0,20	8,00	0,16
	Others	0,00	0,00	2,00	0,04	2,00	0,06	10,00	0,20
		16,00	0,32	32,00	0,64	13,00	0,37	26,00	0,52
Restricted Irrigation	Bean	4,00	0,08	4,00	0,08	0,00	0,00	0,00	0,00
	Maize	7,00	0,14	7,00	0,14	2,00	0,06	2,00	0,04
	Annual	0,00	0,00	0,00	0,00	7,00	0,20	8,00	0,16

		MERCEDES WITH		MERCEDES WITHOUT		COOPERATIVE WITHOUT		COOPERATIVE WITH	
CULTIVATION	CROP	Area	%	Area	%	Area	%	Area	%
	Others	0,00	0,00	2,00	0,04	3,50	0,10	5,00	0,10
		11,00	0,22	13,00	0,26	12,50	0,36	15,00	0,30
Perimeter of prospective irrigation, Mzs			50,00		50,00		35,00		50,00
Crop Intensity			1,54		2,10		1,70		1,96
Year round	Bean	30,00	0,60	44,00	0,88	13,00	0,37	24,00	0,48
	Maize	47,00	0,94	57,00	1,14	34,00	0,97	51,00	1,02
	Annual	0,00	0,00	0,00	0,00	7,00	0,20	8,00	0,16
	Others	0,00	0,00	4,00	0,08	5,50	0,16	15,00	0,30
		77,00	1,54	105,00	2,10	59,50	1,70	98,00	1,96

Source: Pre-Feasibility Study

In terms of crop area by crop period, the importance of the last crop period remains and the crop areas increase significantly during the first and during the unrestricted irrigation period, between the months of November to February. The increased area during the critical months is almost non-existent in both scenarios.

With regard to crops in all of the scenarios, it is estimated that traditional crops of maize and beans will uphold their importance, in the understanding that farmers will continue with these crops because they respond to their established production systems based on their productive requirements and strategies. Nonetheless, the first scenario contemplates a strengthening of these crops with increased cultivated areas, while the diversified scenario contemplates introduction of profitable crops.

Increased Yields

In the situation with the project, the differences in crop yields under irrigation and the situation without a project and without irrigation described in the first chapter have been applied, which were set in the order of 20% and 34% in relation to the average yields for first and last crop periods for traditional crops.

As indicated in the first chapter, yields adopted for the current crops without irrigation, represent the average situation generated by the losses during the first crop period and the good yields obtained in the second period. Yields under irrigation have been adjusted to the best yields obtained to the last crop periods.

In the new crops, the crops registered in the publication Agricultural Trade Guide for Small Farmers have been adopted, published by Save the Children with USAID funds for Nicaragua. Table 6 shows the yields implicit in the elaboration by this study.

Table 6: Crop Yields by Manzana

Nº	CROP	YIELDS WTIHOUT IRRIGATION	YIELDS WITH IRRIGATION	INCREASE
1	Maize	30 tons	40 tons	33%
2	Bean	15 tons	18 tons	20%
3	Maize Corn		30.000 units	0%
4	Pineapple		1.200 dozen	0%
5	Squash		1.500 dozen	0%
6	Sweet Pepper		2.012 packs	0%

Nº	CROP	YIELDS WTIHOUT IRRIGATION	YIELDS WITH IRRIGATION	INCREASE
7	Tomato		1.000 boxes	0%
5	Sesame		12 tons	0%

Source: Pre-Feasibility Study

Climatic Data

Potential Evapotranspiration (PET)

In the study area, there are several months during the year that suffer from water deficit for production, since the potential monthly Evapotranspiration is higher than actual effective rainfall.

The results of the PET estimations for El Sauce Station, which is deemed as representative for Mercedes Basin for the period 1963 to 2005, appear in Table 7:

Table 7: Potential Evapotranspiration (in mm); El Sauce Station 1963 -2005

PET	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Median	135	142	173	188	164	145	157	155	136	125	119	124	1.763
Unleash	24.6	25.2	33.0	33.3	25.3	20.8	24.1	26.2	21.2	18.6	17.3	21.2	275.8
Variable Coefficient	0.18	0.18	0.19	0.18	0.15	0.14	0.15	0.17	0.16	0.15	0.15	0.17	0.16

Source: Hydrological Study

Extraterrestrial Radiation (RMM)

The estimated solar radiation as of Allen et al, (1998), in mm of water evaporation equivalent per month for El Sauce Station appears in Table 8:

Table 8: Extraterrestrial Radiation – El Sauce Station

RMM	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Average	385	386	459	481	467	463	478	479	451	433	381	373

Source: Hydrological Study

Average Temperature

El Sauce Station is taken as the base station for EVTP calculations for the three basins in the study. Average temperature records for this station date back to the year 1963 up to the year 1997, with some interruptions; for this reason, it was necessary to find assistance from a neighboring station in order to fill and extend its data up to the same rainfall period, i.e., to the period 1963 to 2005. San Isidro Barbacoa (Code 69026) was the station that was used.

Table 9: Monthly Average Temperature (in ºC), from 1963 to 2005; El Sauce Station

Temperature	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Average	25,8	26,7	27,7	28,7	27,6	26,3	26,4	26,5	25,7	25,5	25,6	25,5	26,5
Standard Deviation	2,86	2,92	2,96	2,88	2,15	1,64	1,95	2,10	1,69	1,57	1,95	2,38	2,14
Variable Coefficient	0,11	0,11	0,11	0,10	0,08	0,06	0,07	0,08	0,07	0,06	0,08	0,09	0,08

Source: Hydrological Study

Relative Humidity

Temperature records for relative humidity go back to 1963 and up to the year 1997, with some interruptions. In order to extend the data to the same period for the rainfall, i.e., for the period 163 to 2005, assistance from the San Isidro Barbacoa Station (Code 69026) was necessary, as was the case for the temperature.

Table 10: Monthly Relative Humidity (in %), from 1963 to 2005; El Sauce Station

RH	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Average	67,8	64,4	63,5	61,8	73,1	80,7	76,9	77,8	82,5	84,9	79,9	73,7	73,9
Standard Deviation	13,12	13,86	15,29	14,80	10,78	7,43	9,22	10,01	7,97	6,17	7,30	10,56	9,73
Variable Coefficient	0,19	0,22	0,24	0,24	0,15	0,09	0,12	0,13	0,10	0,07	0,09	0,14	0,13

Source: Hydrological Study

Climatic Classification

According to Köppen, the climate in the area of study is typical of the tropics; it is characterized for maintaining high temperatures throughout the year, above 18ºC (type A) and Aw tropical savanna.

According to the classification made by INETER in the Climate Atlas, using modified Köppen, the area under study is classified as Hot Climate and Sub-Humid with Summer Rain; AW (AWo, AW1, AW2). This climate is predominant in all of the Pacific Region and in most of the Northern Region. It is characterized by a dry season (November-April) and another rainy season (May-October). Rainfall varies from a minimum 600 mm in the intra-mountainous valleys of the Northern Region to a maximum of up to 2.000 mm.

Hydrology

During Las Mercedes Project Feasibility Study, a detailed hydrology study was carried out, which determined:

- Amounts of characteristic rainfall for the basin, from the analysis of several stations.
- Flood flows for extreme events with various return periods, which will be useful for the design of works.
- Average monthly flows (yield of the basin), from the use of models and a historical series of data have generated flow values that drain off, calling more attention during the months with the lowest flow, period during which some appraisals were conducted on the River.

- Quality of available water, through laboratory tests and use of Riverside standards for its classification.

Following is a summary of the study that was performed:

Available Information

Table 11 below, shows a list of rainfall stations taken into consideration for evaluation by the Project.

Table 11: Location and Available Data by Station

Station Name	Elevation ASL	Code	UTM Coordinates		Existing Data	
			West	North	From	Up to
San Juan de Limay	281	58002	542765	1457642	1969	2005
El Sauce	180	60005	549668	1424182	1962	2005
Achuapa	330	60006	545254	1442502	1963	2005
Nacascolo	420	60012	557166	1438858	1972	2005
La Montaña	680	69113	562320	1426027	1972	2004
Santa Rosa del Peñón	180	69059	576251	1415837	1996	2005
Cinco Pinos	400	58009	514445	1462238	1995	2005
Valle Santa Cruz	1.010	69063	572911	1440143	1996	2005
San Isidro Barbacoa		69029	591070	1429997	1961	2000

Using both the generation of isohyets and Thiessen polygons, rainfall characteristics for the basin have been established, which are reflected in Table 12.

Table 12: Summary of Rainfall in Las Mercedes Basin; 1963-2005 data

	J	F	M	A	M	J	J	A	S	O	N	D	Average
Average	2,2	1,6	10,6	39,2	223,5	237,0	96,6	162,8	353,3	334,9	73,1	6,8	1541,6
Maximum	6,2	0,4	13,4	14,1	375,0	171,0	276,1	256,5	378,6	730,8	363,9	1,0	2587,1
Minimum	0,5	0,3	1,7	16,6	164,7	193,4	62,6	50,5	60,4	141,3	13,4	54,3	759,7
Standard Deviation	4,5	3,8	19,0	47,9	144,2	123,8	67,4	145,2	146,7	181,3	72,8	12,1	438,7
Variation Coefficient	2,0	2,3	1,8	1,2	0,6	0,5	0,7	0,9	0,4	0,5	1,0	1,8	0,3

Peak Flood Flows

The maximum instantaneous peak flows and their corresponding hydrographs have been estimated through the generation of showers or storms of different probabilities of occurrence, which will generate floods of equal probability. The rains and flooding were determined for the probabilities of 5, 10, 15, 25, 50 and 100 years return periods.

Because the topography and coverage have a direct effect on these estimates, the basin was characterized by dividing it into sub-basins, as shown in Figure 2 and Table 13.

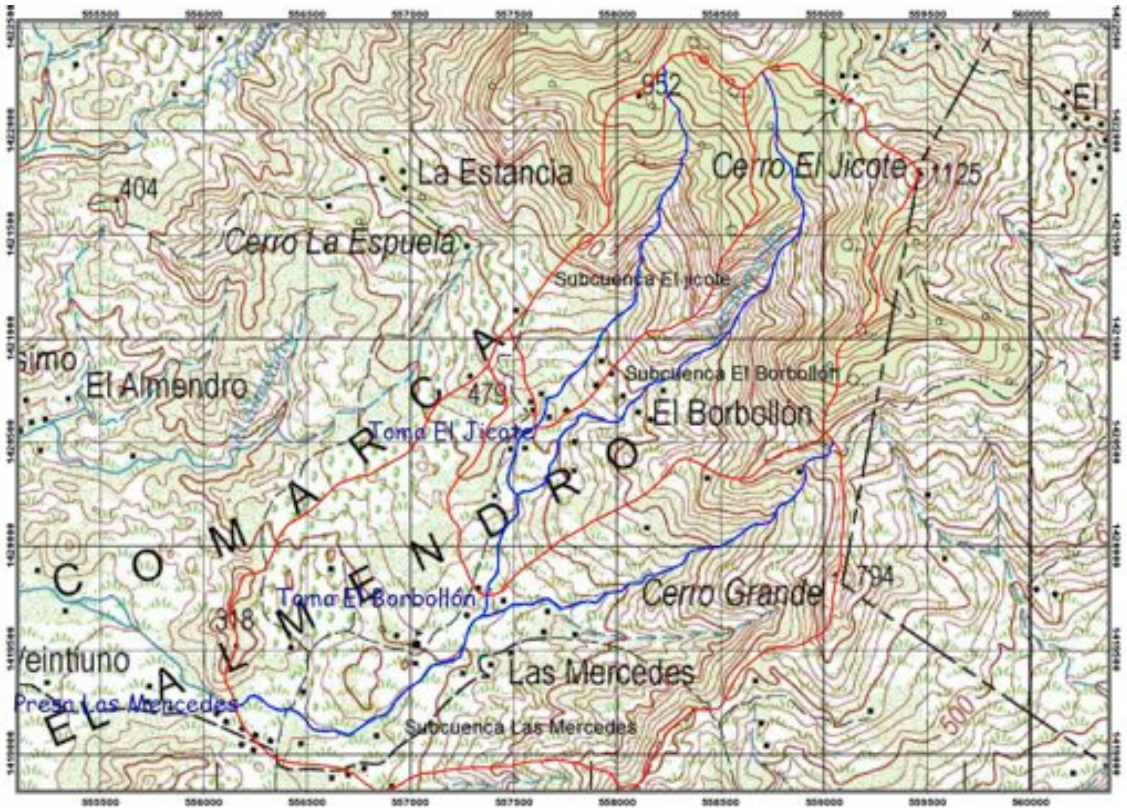


Figure 2: Las Mercedes River Basin

Table 13: Las Mercedes River Sub-Basins

Sub-Basins	Area (in km^2)
El Jicote	1.073
El Borbollón	2.114
Las Mercedes	3.478
Total	**6.675**

The methodology that was used was the Hydrologic Modeling System of the Hydrological Engineering Center (HEC-HMS) developed by the *Hydrologic Engineering Center* of the *US Army Corps*. It is designed to simulate rainfall-draining processes through the representation of hydrologic basins as a system of interconnected hydrologic and hydraulic components.

A characteristic curve value representative number of each sub-basin and a design rainfall to various probabilities of occurrence were established. The results are presented in Table 14.

Table 14: Maximum Flows for Different Return Periods

Return Period	El Jicote Flow (m^3/s)	Cooperative Inlet Flow (m^3/s)
5 years	3,0	25,3
10 years	4,1	33,3
15 years	5,3	41,1
25 years	6,4	48,7
50 years	8,2	60,6
100 years	10,3	74,5

Average Monthly Flows

As Las Mercedes Basin is not controlled by a gauging station, it is necessary to derive its flows through either indirect methods for statistical correlation with other basins or transposing parameters with hydrological models for similar watersheds. Given the impossibility of having a basin with reliable hydrological and meteorological data in the vicinity of the basins of interest, it was necessary to use a basin that met with these information requirements, even if not close to our projects, such as Jiguina Station. This basin has an important feature that is similar to those studied; i.e., its flow is permanent and does not disappear in summer.

Initially, the ""Hydro-meteorological and Flood Calculation Contributions (CHAC)[1]" was proposed for this study, in order to calculate the monthly contributions; however, after a successful calibration, the outputs of flow results showed as minimum values tenths of flows in m3/s, which limits us in these small basins, which at least three decimal places are needed to show the low water flows, so the model was discarded. Instead it was decided to generate a series of flows from the correlation rainfall-runoff model using CLIRUN3. Below are summaries of the flows generated in the Las Mercedes Basin.

Table 15: Average Flows of Las Mercedes River - El Jicote, 1963-2005

Parameter	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Average	0,021	0,015	0,010	0,015	0,058	0,109	0,062	0,080	0,192	0,283	0,081	0,034	0,080
Maximum	0,030	0,021	0,024	0,040	0,372	0,589	0,182	0,638	0,539	1,003	0,285	0,060	0,162
Minimum	0,018	0,003	0,000	0,000	0,019	0,027	0,024	0,020	0,022	0,034	0,026	0,020	0,025
Standard Deviation	0,002	0,005	0,008	0,009	0,064	0,118	0,033	0,104	0,138	0,210	0,043	0,010	0,036

Table 16: Average Flow Las Mercedes River – Cooperative Inlet, 1963-2005

Parameter	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Average	0,017	0,010	0,009	0,013	0,094	0,203	0,103	0,140	0,378	0,573	0,147	0,047	0,144
Maximum	0,039	0,018	0,023	0,065	0,610	1,195	0,288	1,308	1,087	2,175	0,628	0,100	0,317
Minimum	0,009	0,008	0,006	0,004	0,010	0,028	0,018	0,015	0,021	0,045	0,027	0,015	0,029
Standard Deviation	0,006	0,002	0,003	0,010	0,128	0,238	0,064	0,217	0,289	0,458	0,098	0,022	0,074

Minimum Flow

Base flow is the water that infiltrates through the soil in the non-saturated area and passes on to become part of the underground water. Underground water is rarely static, it moves slowly down hill, through the space of the pores, caverns or fissures between rocks, depending on the existing local formations in the location. This water is the main

[1] Developed by the Center for Studies and Experimentation (CEDEX) of the Ministry of Public Works, Spain

source of water currents during the period without rain. The water returns directly to the river bed, beneath the surface or may arise to the surface soil near the river bed and travel short distances before entering the river bed.

Surface water may travel quickly enough to contribute to the canal's water flow during rainfall events. Underground waters that reach the river be or surface soil from the subsoil is called base flow.

During the 2008 dry period, a measurement campaign was performed in order to estimate the base flows or minimum flows, during different dates; these appear on the following table. The flow measured on May 10th was altered by rainfall a few days prior to the measurement and no long reflect the basin's base flow. Due to lack of available hydrological information in the basins that were studies, these values were very valuable because they allow for reliance on reference values for the base flows during low water levels.

Table 17: Flow Measurements, Values in Liters/Second

Date	March-12-08	April-17-08	April-27-08	May-10-08
Las Mercedes Jicote	60	48	29,00	35,5
Las Mercedes Cooperative Inlet	45	38	21,33	26,5

Water Quality

In April 2008, a physical-chemical analysis of a water sample from Las Mercedes River was performed in the Water Laboratory of the National Autonomous University of Nicaragua in Leon. The results of the analysis are included in Las Mercedes Project Feasibility Study.

Chemical Analysis for Irrigation Purposes

According to the referred analysis, the water from Las Mercedes River belongs to Class C1-S1, classified according to Riverside Standards for water for irrigation purposes.

The analysis concludes that it has:

- Low salinity water, apt for irrigation in all cases. Problems may only arise in soils with very low permeability.
- Low sodium content water, apt for irrigation in most cases. Yet, problems may arise with crops that are sensitive to sodium.
- It relies on a very low risk of degrading the plots used.

Table 18 shows a summary of the values obtained, including the pH value, which just under the normal value (6-8,5).

Table 18: Laboratory Analysis Results of Las Mercedes Waters

Parameter	Result	Unit
pH	5,66	
Conductivity[2]	71,4	µS/cm
Rate of sodium absorption (RSA)	1,06	meq/L

Geology

During Las Mercedes Project Feasibility Study, a geological inspection was performed of the anticipated construction sites of water intakes and the course of the anticipated work sites.

The areas involved correspond to the river's Mercedes at the start of the sector called Borbollón. A strip of land where the proposed work site for the Central Mercedes system piping and the current work site of the old water intake for the Ismael Castillo Cooperative.

Regional Geology

Regionally, the project area and its environment are characterized by a mountainous setoff, aligned hills, with slopes ranging from 50 to 85%. Within this geological frame, the intra-mountainous valley or plain areas are located, which complete the geomorphologic characteristics of Los Almendros-San Nicolas corridor, creating a draining system with lineal, rectangular and sinuous patterns.

The above stated characteristics represent groups of massive accumulations of volcanic rock of basaltic-andesitic flows. Tertiary belonging to the Coyol Group (MC Birney & Williams, 1965), with intermediate and acid composition, associated with smaller scale intrusive rocks.

Geology of Construction Sites

Cooperative Intake Works

The platform of the site where the old axis of the dam site of Las Mercedes River, consists of alluvial deposits and loose blocks of lava; in the immediate margins of the river, alluvial terraces are located that are also formed by the same river bed material (see Table 19).
There are, beneath the sediment of rocky basaltic body flows that outcrop at 250 meters NE of the axis of the outlet; these are in front of the house of Mr. Antonio Gonzales, on the main road.

[2] 1 µS/cm = 1 µmhos/cm

Table 19: Lithostratigraphy of cooperative intake

Lithologic unit (From top to base)	Thickness (in meters)	Observations
(**Limit**) Alluvial River Terrace	0,20 – 0,50	Loose sediments of sand, gravel, clay and angular boulders.
Residual Soil	0,20 – 1,00	Clayish sediments
Andesitic - basalt (Base)	(1,00 - ¿)	Lava flows with breach texture, fractured

Central Mercedes Intake Works

The platform that outcrops throughout the length and width of the selected site for water intake for Central Mercedes consists of weathered basalt rocky banks, which appear with a massive geometry on both sides of the base of the river.

In this area, the geomorphology of the river is narrow, facilitating the uptake of water. On the west bank, it is slightly tilted about 25 - 40 degrees, with a height between 2-6 meters high, allowing information on the structural conditions and foundation of the slope where the work will be placed. On the opposite side is an altered rock slope with inlaid scattered basalt with different diameters. High clay concentrations of clay surround blocks of basalt, which support the stability of the walls of the water intake site.
At the proposed site for the water supply intake, the stratigraphic sequence is in conformity with Table 20, below.

Table 20: Lithostratigraphy of Central Mercedes Intake

Lithologic unit (From top to base)	Thickness Meters	Observations
(**Limit**) Alluvial	0,10 – 0,20	Thin layer of loose sediments of sand, gravel, clay and angular boulders.
Residual Soil	0,20 – 0,50	Sandy-clayish sediments with inlaid meteorite rocks, clay and angular boulders.
Weathered basalt (Base)	1 - 2	Lava flows with aphanites texture, slightly fractured and a highly meteorite rock matrix.

Conduction System

The location of channels and art works in the area of the cooperative will be made by following much of the existing route; the first section has alluvial soil with loose blocks of basalt with sporadic outcrops of basalt.

The remaining sections where work shall be placed correspond to coluvial soils, which currently have a lot of vegetation and farmland.

Pipeline System

The pipeline network in the Central Mercedes system will be placed on the right bank of Las Mercedes River. The first route will be placed on a highly weathered stratum.

In order to facilitate the excavation of the trench, the proposed site is on agricultural land where residual soil has a depth of 50 to 80 cm.

The first progressive will be the most difficult to excavate because small basalt andesitic rock is outcropping.

Loan Banks

Given the low volumes of aggregate for concrete production, it is proposed not to enable a new bank for this project but to proceed to purchase these from local suppliers.

The sand will be provided from Los Limones River (UTM coordinates 1426167 to 546515), which has been tested for grain size and weathering. While the results of weathering mark a value slightly higher than the recommended range, it is anticipated that dosages will be established prior to making such concrete.

The gravel is expected to be gained from the plant located at the junction of the road Leon - Telica, from a processing plant. Costs in the price survey covered such provision.

Topography

Once the hydraulic scheme that meets the demands of the irrigators was defined, we proceeded to make the planimetry-altimetry survey of the proposed site for construction of the outlet, and the alternatives for possible outlines for the decanting channel and location of the main pipelines.

At this stage, the project has been delayed considerably due to the inexperience of surveyors in such surveys, having to be continuously adjusted and corrected according to the need for artwork and best steps possible.

Special care was taken to plant-level banks every 500 m in places where it is expected to build special works. These are identified on the plans.

Precision of the works performed has been controlled by the construction of polygonal uplifting.

Once the preliminary design was done, we proceeded to the preliminary layout work, so that together with the boards of directors of the irrigators' associations, the rights of way and easements for the aqueduct can be confirmed.

It is hereby made clear that the reconsideration does not correspond in some sections to the final location of works due to modification requests made by users for concession of easements.

The Project

Water Use; Agricultural Production and Other Uses

Description of Different Uses

Two irrigation systems were identified in the project area: one at the middle basin, between 360 and 240 meters above sea level, characterized by individual water exploitation through sprinkler irrigation systems; and the second, located in the flat part of the area, between 205 and 240 meters above sea level, characterized as a collective system, which uses the water through a mechanism operated by gravity.

Central Mercedes Irrigation System

The Central Mercedes irrigation system is located in the middle basin, below 360 meters above sea level, which corresponds to the union of Mercedes River's streams, above 240 meters above sea level, which corresponds to the boundary with the plots of land of the Ismael Castillo Cooperative on the lower basin.

Currently, there are no collective rights for the use of water because each user has their own catchment with pipes placed on Las Mercedes River.

According to the information from the diagnosis, 10 irrigators currently use the waters of Las Mercedes River to irrigate 18 mzs of land, with an aver 1,82 manzanas per irrigator and for which they use 33 sprinklers, mostly with a ½" diameter. A detailed analysis is contained in the Las Mercedes Management document (refer to Annex 19).

The Central Las Mercedes System irrigation period normally begins during the month of November, once the rainy season is over, and continues up to the first days of the month of May, when the rainy season begins.

The irrigators in the sector have not developed ways to distribute the water because each one of them has their own irrigation system at the point of catchment to the plot of land; therefore, each irrigator does so according to his or her own criteria, without necessarily complying with other activities that are implicit in management, such as organize themselves, contribute, take turns and perform cleaning and maintenance activities to operate the system.

The Cooperative's Irrigation System

The Cooperative's irrigation system is located on the lower basin, approximately between 240 meters above sea level (where the Ismael Castillo Cooperative's plots begin) and 205 meters above sea level (boundary with the plots of land belonging to Mr.

Ciro Pastora); it is characterized by its collective nature and for applying a surface irrigation system.

The irrigation system benefits 10 users and covers an area of 35 mzs (24,6 Ha); yet, it could potentially reach up to 50 Mzs, considering that the plots of land of the Cooperative cross the road that leads to Central Mercedes and Borbollón.

The irrigation infrastructure on the left margin consists of damaged intake works and a 200 meter main channel that runs between the boundaries of Mr. Vicente Castillo's property with Mr. Antonio Gonzalez and Mrs. Indira Castillo. Although the first 30 meters of the canal are masonry, it losses great amounts of water along its course. The analysis of the current system's operations is contained in Las Mercedes Management Document in Annex 19.

The Cooperative's irrigation system, with a perimeter of 35 manzanas, serves 18 manzanas of crops currently irrigated during the irrigation period during the months between December and April.

Use and Exploitation of the Water in the Basin

Different types of uses and rights to usufruct the water in the basin have been identified, both upstream and downstream of the project area, which are described below, as well as its impact on the use of irrigation systems in the project.

Use of Upstream Waters

In the upper basin, which lies above the 360 meters above sea level, are the sources of water from a series of springs called El Borbollón.

In this sector there are two irrigation systems which are sources of water catchments. The above systems cover a potential area of 25 Mzs, but according to information gathered in the field - through interviews - watering systems irrigate between 8 and 12 net manzanas.

Irrigation systems work with spray and using pipes of different diameters (½ to 2 inches), to capture and lead the water to their land where the sides are usually ½ inch diameter polyethylene pipes. The irrigation is done with sprinklers and the vast majority is ½ inch.

Once the waters have reached the streams, it is recognized that these are already owned by the State and thus can be captured freely by farmers whose lands have access to them.

In the area of Borbollón there is no water deficit, despite some inefficiency in catchment, handling or application. In fact, much of the flow feeds streams that give rise to Las Mercedes River.

The steep slopes of the irrigation area and the presence of rocky ground are the most significant limitations, as farmers must perform preliminary land preparation tasks.

Since the best land and most important production areas are located downstream, it was not was not considered relevant to conduct irrigation improvement works in the headwater sector.

Use of Downstream Waters

In the lower basin, below the site of the Cooperative, there are several properties whose main economic activity are livestock and need water for the water troughs during the critical months of March and April.

Six owners have been identified - with a total of approximately 250 head of cattle - that tap into different parts of the Mercedes River downstream from the outlets of the Cooperative. Competition and conflict over water usually occur in April and recent dispute was reported over the death of animals due to lack of water in the river.

In this regard, it may be stated that while there is no clear regulations or arrangements made for the distribution of water among users in the basin, the fact of having faced two previous conflicts, has led to a decrease in irrigated area during the critical period, which helps relatively reduce negative effects downstream.

Due to the above issues, we can conclude that it is vital to have an ecological minimum flow to meet the watering needs for the 250 head of cattle identified.

Water Balance

The balances of supply and demand of water were performed on time to define the future production scenarios that ensure that water supply is sufficient for the implementation of the proposed crop cards.

The calculation procedure of calculation applied was as follows:

- Determine the monthly supply of available water in Las Mercedes River
- Calculation of the water demand for the proposed scenarios
- Application of a balance of water supply and demand

Additionally, the increase of cultivated area under irrigation in the scenarios taken into account was established

Water Offer for Irrigation

The water offer for Las Mercedes Irrigation Project comes from Las Mercedes River course, the flows of which depend on:

- Springs of water in the dry season or summer, and
- Rainfall during the season

Water supply for the rainy season was generated based on a hydrological study. The supply of water in the dry season was generated based on stream gauging performed during the months of March and April 2008.

The determination of the rainy season and dry season was performed according to probable rainfall data at 75%, which show that between the months of December and April, rainfall is less than 2 mm and greater than 15 mm between May and November.

The methodology applies to establish the monthly water offer is described in detail in the pre-feasibility study and the results appear on Tables 21 and 22, which evidence that the offer for the Cooperative depends on consumption in Central Mercedes.

Irrigation Water Demand

Once the productive scenarios have been designed, the water demand for each crop card was defined by applying the procedures and methodologies proposed by FAO, based on the following scheme:

- Referenced Evapotranspiration
- Crop Evapotranspiration
- Net and gross irrigation requirements for each crop

The climate information used corresponds to El Sauce Station, which relies on HMO type station and therefore, with the temperatures, cloudiness, relative humidity and rainfall data.

Reference Evapotranspiration

Although the Hargreaves method was applied in the hydrological study, the potential Evapotranspiration was stimulated, resulting in 1.762,5 mms/year; in order to calculate the crop irrigation needs, the Penman-Monteith method was applied as recommended by FAO, resulting in 1.774,65 mm of annual ETR.

To calculate the ETR, the spreadsheets elaborated by the A.G.U.A. Center of the Superior University of San Simon de Cochabamba, Bolivia were used. The pre-feasibility study contains detailed calculations and climate data used.

Crop Evapotranspiration

In order to calculate crop Evapotranspiration, the methodology recommended by FAO in its publication Nº 56 of the Irrigation and Drainage series, titled Crop Evapotranspiration was used. Crop coefficients were obtained from the tables contained in the referred to document and the concepts referring to standard Evapotranspiration were used. The pre-feasibility study contains the values assumed for Kc (crop coefficient), as well as other details referred to the application of the selected methodology.

Irrigation Requirements

To calculate the net irrigation requirements, the rainfall data generated by the climate study for Las Mercedes sector was used. In conformity with FAO recommendations, the probable rainfall at 75% was used instead of the average monthly rainfall.

To calculate the gross irrigation requirements, the following efficiency values were used:

Concept	Central Mercedes	Cooperative
Main conduction efficiency:	95%	60%
Lateral conduction efficiency:	90%	90%
Efficiency of application:	75%	60%

In the case of Central Mercedes, the considerations were that when dealing with a sprinkler system, the supply flow will be conducted through pressure pipes, including for the plots of land. The value of 75% for application of irrigation to the plots was assumed, considering the existing irrigation experience in the sector. Total efficiency of the proposed system is 65%, which is acceptable for a pressurized irrigation system with collective management by small farmers.

The cooperative's canal system has problems at its initial segment and its 60% efficiency reflects the magnitude of losses by conduction. The 90% value for the secondary canals was obtained by flow gauging in different segments of the canal and the value of the efficiency of application was estimated by observing the slopes and relief of the plots, flow management and surfaces under irrigation. Total system efficiency is 32%, value which is representative of this type of system.

All of the described considerations have calculated the monthly water demands for the crop cards without the project and with the project for the Central Mercedes and Cooperative systems.

Balance of the Water Offer and Demand for Irrigation

Once calculations of the water demand for irrigation of the different crop cards were made, the balance of the water offer en demand was performed. Calculation procedures appear in the pre-feasibility study and a summary of the results obtained for Central Mercedes appear in Table 21.

The table evidences that if a sprinkler irrigation system is implemented, the system is capable of operating problem free for the irrigation of 50 manzanas that conform the irrigation perimeter throughout the year except during the critical months of March and April, when only half or less of the perimeters (20 manzanas) should be cultivated.

Table 21: Balances of the Monthly Water Demand and Offer for Central Mercedes, in l/s

	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May
Offer	38,5	29,5	23,5	43,0	73,0	40,5	38,7	31,0	23,2	15,5	10,0	22,5
CURRENT CARD												
Area (mzs)	0,0	0,0	0,0	0,0	8,0	16,0	16,0	15,0	11,0	11,0	4,0	0,0
Demand	0,0	0,0	0,0	0,0	0,0	5,9	9,2	5,5	6,6	8,1	2,6	0,0
Balance	38,5	29,5	23,5	43,0	73,0	34,6	29,6	25,5	16,7	7,4	7,4	22,5
CARD WITH PROJECT												
Area (mzs)	30,0	30,0	30,0	32,0	50,0	32,0	34,0	21,0	13,0	13,0	4,0	30,0
Demand	0,9	11,9	1,1	0,0	0,0	13,1	18,8	8,6	7,9	9,1	2,6	0,0
Balance	37,6	17,6	22,4	43,0	73,0	27,4	20,0	22,4	15,3	6,4	7,4	22,5

Notes: Offer: Monthly offer in l/s.
Area: Crop area under irrigation in manzanas

Demand: Monthly water demand for irrigation in l/s.
Balance: Balance of water offer and demand in l/s.

Source: Pre-feasibility Study

Balance results show that it is necessary to establish that the irrigation period without restrictions can extend itself only up to the month of February; as of that date, only the manzanas that are currently under irrigation should be irrigated in order to leave water in Las Mercedes River to cover downstream requirements.

Table 22 states the results of the calculation of the water offer and demand for the Cooperative sector as follows:

Table 22: Monthly Water Offer and Demand for the Cooperative, in l/s

	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May
CURRENT CARD												
Offer	46,5	37,0	23,5	56,5	115,5	47,1	43,6	36,6	25,1	13,0	7,5	22,5
Area (mzs)	22,0	22,0	22,0	33,0	33,0	22,0	13,0	13,0	14,5	12,5	12,5	22,0
Demand	1,3	15,0	1,8	0,0	0,0	13,3	9,8	8,6	8,7	11,4	10,3	0,1
Balance	45,2	22,0	21,7	56,5	115,5	33,9	33,8	28,0	16,4	1,6	Deficit	22,4
CARD WITH PROJECT												
Offer	45,6	25,1	22,4	56,5	115,5	39,9	33,9	33,5	23,7	12,0	7,5	22,5
Area (mzs)	33,00	33,00	28,00	48,00	50,00	42,00	26,00	31,00	23,00	15,00	10,00	33,00
Demand	1,92	20,35	1,68	0,00	0,00	21,56	18,92	21,16	17,17	10,60	5,95	0,12
Balance	43,69	4,79	20,75	56,50	115,50	18,36	14,99	12,36	6,52	1,42	1,55	22,38

Notes: Offer: Monthly offer in l/s.
Area: Crop area under irrigation in manzanas
Demand: Monthly water demand for irrigation in l/s.
Balance: Balance of water offer and demand in l/s.

Source: Pre-feasibility Study

The results of the above table show that during bad years, it can be anticipated that the water deficit will persist during the month of April, pointed out in the balance with "deficit"; in this case, the water offer varies according to the water consumption in Central Las Mercedes. Once again, flow demands are in the order of 20l/s during the critical month of July due to the Indian summer phenomenon.

Increased Crop Areas under Irrigation

Given the positive results of the water offer and demand balances that show non-deficient situations in all of the scenarios, the following conclusions can be stated:

- By implementing the system, an increase in the physical area can be anticipated, from 53 manzanas currently to 100 manzanas in the future, by expanding the irrigation perimeter.
- The highest water availability allows to anticipate the annual crop under irrigation at 86,5 manzanas to increase to 203 manzanas, establishing an increase of 116,5 manzanas.

Water Rights and Irrigation Areas

Basic Considerations

Las Mercedes Irrigation Project identified two system operation periods to establish water use rights:

- The critical period from the month of March to the early rainy season in the month of May.
- The normal period from the initial rainy season up to the end of the month of February.

Based on the periods considered, water use rights were established as follows:

- The right to water use during the critical period is restricted to the current irrigators based on the number of sprinklers and the inventory of irrigated areas performed in this study.
- The right to water use during the normal period is open to all beneficiaries taken into consideration in the study, based on the number of sprinklers and the areas designated in the hydraulic design.
- Stockbreeders have a special right to use despite being a new right, which applies during the critical period.

Designation of rights to water use will depend on the contributions made by prospective beneficiaries as counterparts to the cost to implement the material works. The right depends on the area of irrigation and a counterpart of 20 days wages per manzana was allotted.

Types of Rights

Considering the above concepts, two types of rights to water use have been designated: **old rights** for currents users of water for irrigation, and **new rights** for farmers that will irrigate or use water as of the irrigation project execution.

Table 23 presents a summary of the number of beneficiaries by sector, distinguishing the type of right designated.

Table 23: Number of Beneficiaries and Type of Right by Sector

N°	SECTOR	Old	New	Total
1	Central Mercedes	17	25	42
2	Ismael Castillo Cooperative	11	3	14
3	Stockbreeders	0	9	9
	TOTAL	**28**	**37**	**65**

Source: Las Mercedes Management Design (Annex 19).

According to the information on the above table, Las Mercedes Irrigation System has 28 (43%) old irrigators and 37 (57%) new users, of which 9 (14%) are stockbreeders that will use the water to water their animals.

Rights to Water Use by Sectors

The rights to use by sector are limited by the available water offer during different periods, expressed in the number of sprinkler equivalencies for Central Mercedes, area

in manzanas for the Cooperative, and daily water volume for the stockbreeders. Table 24 presents the relation between the rights for the diverse sectors taken into account:

Table 24: Rights to Water Use by Sector

N°	SECTOR	Mercedes	Cooperative	Stockbreeders
1	NORMA PERIOD			
	Sprinklers or Areas	97 sprinklers	45 manzanas	
	Flow at the Sector Inlet r	30 l/s	45 l/s	
2	CRITICAL PERIOD			
	Sprinklers, area or heads	45 sprinklers	15 manzanas	400 heads
	Flow or Volume at the Sector Inlet	15 l/s	15 l/s	40.000 m^3

Source: Management Information

The above table shows that the number of sprinklers that may be operated by the current irrigators with the minimum flow during the critical period is 45 1/2" sprinklers. On the other hand, the maximum area that the Cooperative can irrigate during the critical period is 15 manzanas.

During the normal period, taking into consideration flow availability during the Indian summer and the month of February, the maximum anticipated number of sprinklers operating at the same time is 97, and the maximum area under irrigation in the Cooperative is 45 manzanas.

Table 25 records net areas or designation of user plots by irrigation block; these blocks have been defined based on the location of users in the system, its detailed description is presented in Annex 19.

Table 25: List of Beneficiaries from Central Mercedes

N°	BENEFICIARY NAME	Nº Sprinklers	Block 1	Block 2	Block 3
1	Nicolas Concepción Rocha T.		0,75		
2	José Luis Rocha Luna	3	2,00		
3	Gustavo Castillo Luna	3	1,51		
4	Santiago Rocha Luna	2	2,00		
5	Terencio de Jesus Rocha	11	3,07		
6	José del Carmen Rocha		0,75		
7	Neptalí Rocha Martinez	7	1,06		1,13
8	Leoncio Rocha Martinez	3	1,51		
9	Andrés Ezequiel Rocha Martinez	3	0,61	0,75	
10	Luis Manuel Rocha Castillo	2	1,94		
11	Julio Cesar Caceres	5	0,97		
12	Juan Pablo Bucardo and sisters	13	2,64		
13	Ramiro Murillo		0,38		
14	Rodolfo Castillo Pichardo			0,75	
15	Luis Manuel Murillo Luna			0,75	
16	Amado Cresencio Murillo Luna			0,75	
17	Alcides Murillo Luna			0,49	
18	Pedro Carrero			0,75	
19	Denis Martínez Membreño			0,35	
20	Victoriano Perez Espinoza			0,35	
21	Ofelia Martínez Membreño			0,57	
22	Nilda Carrero			0,58	
23	José Fredys Castillo Caceres			0,75	
24	Jairo José Machado Rocha			0,56	
25	German Altamirano Carrero			0,75	
26	Bernardo Valverde			0,25	
27	Juan José Gonzales Espinoza			0,25	
28	José Ramón Espinoza			0,25	
29	Gloria Maria Rocha Pichardo			0,75	
30	José Benito Murillo Luna	6			2,00
31	Sofia Antonia Murillo	3			1,06
32	Gumercinda Castillo Castillo	2			2,00
33	Noek Rocha Pichardo	5			1,54
34	José Ismael Corrales Lanuza				0,25
35	Jerónimo Molina Rodriguez	2			0,20
36	Candido Molina Rodriguez				0,20
37	Julia Perez Gonzales	2			0,20
38	Donato Gonzales				0,19
39	Pedro Armengol Gonzales Gonzales				0,17
40	Filiberto Gonzales				0,18
41	Pablo Antonio Gonzales Molina	3			1,41
42	Yadira Castillo Icabalzeta				0,56
	TOTAL	**75**	**19,21**	**9,65**	**11,09**

Source: Management Design

The data in the above table show that Las Mercedes Sector has 42 users of which 17 (40%) are old-time irrigators and the remaining 25 (60%) are new.

Rights Assignment in the Cooperative

In the case of the cooperative, rights assignment to water use has been made based on the location of the plots of land, anticipating water distribution to three irrigation blocks.

According to plot location, there are users with new rights and plots with old time use rights.

The management design document in Annex 19 includes a detail of the users, the area of their plots by block and the type of right assigned to the plot. Table 26 presents a summary of the areas by user, by block and the type of right.

Table 26: List of Beneficiaries from the Cooperative, Area in Manzanas

N°	BENEFICIARY NAME	BLOCK 1	BLOCK 2	BLOCK 3	TOTAL AREA
1	Vicente Castillo	5,62	4,74	2,00 (*)	12,36
2	Pedro Castillo	2,65	0,75	2,92 (**)	6,32
3	Felix Cárcamo	2,09			2,09
4	Benito Icabalceta		1,56		1,56
5	Noel Valverde			2,00	2,00
6	Javier Valverde			1,94	1,94
7	Ananias Castillo			0,37	0,37
8	Daniel Castillo			0,41	0,41
9	Juan Castillo	4,90	6,38		11,27
10	Fernando Hernandez	1,24	1,20		2,44
11	Ciro Pastora		2,00 (*)		2,00
12	Yadira Castillo			1,00	1,00
13	David Rivas Reyes			2,00 (*)	2,00
14	Arnulfo Asunción Rivas			2,00 (*)	2,00
	TOTAL	16,49	16,63	14,64	47,77

Notes: (*) Rights for new use
(**) the plots with 0,92 Mzs with old time rights, the ones with 2,00 Mzs with new rights
Source: Management Design Report (Annex 19)

The data in the table above shows that 10 blocks correspond to new water use rights while the remaining 38 blocks have old time rights of use. Three users have new rights only, two with the two types of rights and duties and the remaining nine users only with exclusive old time rights.

Assigning rights to Cattlemen

As explained in the pre-feasibility study, this project aims to solve conflicts by the use of water, have repeatedly occurred in the project area and in this regard “stockbreeders” are included as water users during the critical period, as of the irrigation infrastructure of the Cooperative.

Table 27 shows the list of stockbreeder that joined the project as new water users and the number of animals recorded for each of them. The allocation of rights to stockbreeders has been made considering a total of 400 cattle with a daily consumption of 100 liters per head, which leads to a volume of 40,000 liters per day during the critical period.

Table 27: List of Stockbreeders

BENEFICIARY	HEADS	BENEFICIARY	HEADS
Maria José Pastora Icabalzeta	16	Mario Cecilio Icabalzeta	40
Ciro Eden Pastora Icabalzeta	10	Arnulfo Asunción Rivas (*)	20
Ciro Pastora Centeno (*)	80	Marcelino Valverde	90
Abraham Castillo Castillo	50	José Manuel Perez	14
David Esteban Rivas (*)	25		
TOTAL	181		164

Notes: (*) They now appear with new use rights in the Cooperative
Source: Management Report

General Description of the Required Works

Considering the distance between each of the groups involved and the differences in the methods of applying water to the plots, we propose to build infrastructure that frees the operation of each group so that they are independent from each other. This will simplify the operation and generate clear agreements for water use.

For the Central Mercedes system, construction of a catchment on the right tributary of the Las Mercedes River is proposed, from which it will be possible to load a pressure pipe network.

Once water is captured, construction of a sand trap and a spout for surpluses will be needed, as well as a stretch of canal where a gauge shall be located in the system, as required by law.

At the end of the referred canal, the proposal is to build a discharge chamber, from which the pressure system will unload.

Because the difference in height between the loading chamber and the last hydrant surpasses 90 mca proposed building a break-pressure chamber located in the middle of the main.

Because the difference in height between the loading chamber and the last hydrant is over 90 mca, the proposal is to build a break-pressure chamber located in the middle of the main piping.

The irrigation perimeter includes irrigation of plots on both sides of the river. In the first section the plots are located on the right terrace and on the final section; they concentrate on the left side of river. So it will be necessary to cross the Las Mercedes River.

For the delivery of water, placement of water hydrants is proposed, which will shut-off valves to control the flow and pressure delivery to each parcel. These hydrants will be located in boundaries of plots distributed so that no user is farther away than 100 meters from the hydrant.

Rehabilitation of the catchment, to be adapted to better hydrodynamic condition and construction of a new outlet canal and its protection system for it is proposed for the cooperative.

To reduce water losses by percolation in the channel, canal lining is proposed in the early stages, and the construction of irrigation distributors. The design flow for the major network channels is 50 l / s.

To provide water to livestock breeders' animals and save water for laundry, we propose the construction of a reinforced concrete reservoir, located in the lower river.

Operation of the future system

Las Mercedes Irrigation Project is located in Las Mercedes Region, belonging to the municipality of El Sauce in the Department of León and benefits a part of the population of the villages in Central Mercedes and the Cooperative Ismael Castillo.

In the Las Mercedes there are three clearly distinguished sectors: Central Las Mercedes, the Cooperative sector and the animal drinking troughs sector.

Central Las Mercedes sector operates with an autonomous system with its own irrigation infrastructure, separate from the one planned for the Cooperative. Central Las Mercedes sector will be watered with a sprinkler system while the sector of the Cooperative will be watered by gravity through a system of canals.

The Cooperative System is assigned to a third area called "Stockbreeders" who receive the water supply for watering their animals from the channels of the Cooperative.

The Central Mercedes System has the following irrigation infrastructure: take, adduction channel and sand trap to overflow, water main driving pressure chamber breaks and fire hydrants.

The Cooperative's irrigation infrastructure system has the following components: collection, main channel, secondary channels and delivery lock gates, additionally incorporating a water tank at the end of it in order to store water for "stockbreeders."

Water Distribution in Central Las Mercedes

To plan and design the water distribution system in Central Mercedes the following criteria or parameters were taken into account: frequency of watering every three days, ½-inch rotating sprinklers, two irrigation shifts per week and the net area of assignment.

Reference Sprinklers

Taking into account the experience of the future beneficiaries in the use of sprinklers, the design of the system has incorporated the technical conditions in Table 28.

Table 28: Reference Sprinklers per Beneficiary

Size	mca	Flow	Wet Area	Intensity	ETC max.	Frequency
½ inches	20 m	0,3 l/s	170 m^2	5,12 mm/hr	5,5 mm/day	3 days

Source: Management Report

Based on the conditions described in the previous point, the basic conditions of operation of the sprinkler system by reference to each user was initially determined. The management design document (see Annex 19) shows the relationship of users per block and the number of reference sprinklers considered based on their areas.

Table 29, presents a list of the irrigation blocks, areas of assignment and reference number of sprinklers assuming that the system will work continuously day and night with the described technical characteristics.

Table 29: Reference Sprinklers by Block in Central Las Mercedes

N°	IRRIGATION BLOCK	AREA (in m^2)	AREA (in Mzs)
1	BLOCK 1	134.467	19,21
2	BLOCK 2	67.528	9,65
3	BLOCK 3	77.637	11,09
	TOTAL	279.632	39,95

Source: Management Design

Water Distribution in the Ismael Castillo Cooperative

In the cooperative irrigation system, taking into account the experience of the intended beneficiaries in the surface irrigation, weekly watering times per user and per block have been established, trying in as much as possible, to supply water for 10 hours per manzana, with an expected flow of 10 to 12.5 l/s, which can provide a water depth of 50 mm.

A detailed analysis for water distribution during the normal and critical periods is presented in the Las Mercedes Management Document.

System Operation

The Las Mercedes irrigation system provides for two types of operation and coordination between two or three sectors that use Las Mercedes River water. The types of intended operations are:

▪ Normal operation during the period between the onsets of rains until the end of February

▪ partial system operation during the critical period from March until the onset of rains in May

The operation of the system will be borne by the users themselves or contracted by operators designated by the users from Central Las Mercedes the Livestock Breeders, and the Cooperative, for operating activities that include the following functions:

▪ Coordination and control of water supply to user sector

▪ Supply and distribution of water flow to the hydrants in spray and surface irrigation blocks

▪ Control of excess water and drainage

▪ Control and operation of special projects: sand traps, loading chamber

▪ Application of water cutoffs

▪ monitoring of sprinklers

Normal System Operations

The normal operating period is characterized by sufficient water supply to meet the demands of crops in different sectors for which no provision of coordination activities are anticipated between operators.

During the normal operating period, both new and old users irrigate so that all hydrants and irrigation blocks will operate based on the distribution patterns presented in management document.

During this period, times of high overflow in Las Mercedes River are anticipated, so handling overflows and drainage of excess water are important activities. Operating activities are the responsibility of the operator in each sector and these include:

- Check the inflow of the anticipated normal operating intake
- If there is deficiency or excess, correct the situation by manipulating the inlet and overflow gates
- Establish a level of operation with stop locks in entry sector into the system
- Record on a daily basis, the inflow entering the system and if there is a remnant in the river flow
- Monitor and record compliance with the established irrigation shifts in the distribution scheme
- As a preventive measure close the intake damper if rain threatens until the situation is regularized.

Partial operation of the system

The partial operation period is characterized by the management and distribution of a limited flow of water which provides control and coordination activities between the sectors concerned by the following indicators:

- Inflows to the systems
- Sprinklers working
- Lock gates closed and areas in the Cooperative under irrigation

During partial operation of the system, it is anticipated that new users should not irrigate so that, in addition to the activities listed for full operation of the system, the operator must perform the following additional activities:

- In Central Las Mercedes, close the hydrants of new users
- In the Cooperative close supply gates to the expansion plots
- In Central Las Mercedes record and control that sprinklers that operate per user, do so on the basis of the distribution scheme developed in the Table.
- In Central Las Mercedes Center control the total number of sprinklers operating at the same time so that they do not exceed 45, as set out in regulations.
- in the cooperative, control strict adherence to the role of irrigation shifts, especially in relation to hours of water supply to stockbreeders.

During the partial operation period, it will be of particular importance that the established coordination and control mechanisms function between the operators and sectors through inter-sector commissions that may be created.

User Organization

In terms of the organization of users, it is expected to enhance the existing Las Mercedes Irrigation Association (ARME) by defining the following levels of organization: General Assembly, Board of Directors and Operator.

Las Mercedes systems require the creation of an inter-sector committee to coordinate and resolve any conflicts over use that may arise during the critical period of partial operation.

Operators will be people hired by the association, which must satisfy the specific activities outlined in the manuals and regulations for the future operation and maintenance of the irrigation system.

Irrigators' Association

Users of the irrigation system are organized according to Las Mercedes Irrigation Association (ARME) whose regulations are part of this document and are reflected in Annex 1. The Association for Administration and Management of Las Mercedes Irrigation System is constituted by a directive, a Conciliation Commission and the Assembly of Associates. The Board of Directors is comprised of the following members:

- A President
- A Secretary
- A Treasurer
- Two Members

The Conciliation Commission is integrated in the following manner:

- A representative from Central Mercedes
- A representative from the Cooperative
- A representative from the Stockbreeders

The General Assembly is integrated by all of the members of the Board of Directors and by the members of the Association. The attributions, powers and obligations of all of the above are set forth in the Bylaws of the Association in Annex 1.

System Operator

System operators are responsible for operating the water inlets, the lock gates and the hydrants that integrate the irrigation system. They are local people hired by the Association and whose most important functions or activities are described by the normal and partial operation of the system.

System Maintenance

Basic Principles and Concepts

Maintenance of Las Mercedes Irrigation System includes a series of actions that should be included in the following types of maintenance:

- Regular or routine maintenance without an interruption of the water supply
- systematic or regular maintenance with scheduled suspension of water supply
- Emergency maintenance with suspension of water supply

User involvement in system maintenance activities shall be two terms or types: with monetary contributions and contributions in labor (wages)

Participation in both currency and wages are in proportion to water rights acquired and recorded on payment commitments entered into by farmers, so the following rule applies:
"He who has greater rights for use of water, takes or uses more water and therefore contributes a greater proportion"

Socio-Economic Evaluation of the Project

Value of Agricultural Production

Value of Agricultural Production without the Project

Considering the cultivated surfaces, both without irrigation and under irrigation, within the future project perimeter, the benefits of annual agricultural production have been determined, considering the costs and benefits per manzana of cultivation.

Table 30 presents a relation of the production costs, revenue and benefits per manzana, expressed in American Dollars and multiplied by cultivated areas. the results that appear on the table show that the net revenue or benefit generated by agricultural production of the area within the future irrigation perimeter, in the current situation without the project, is USD 57,036.

Table 30: Value of the Current Production in the Area without the Project, in USD

CROPS	AC	Cost Mzs	Total Cost	Revenue Mzs	Total Income	Net Benefit
Irrigated Bean	25,0	463,9	11.599	947,4	26.053	14.454
Irrigated Maize	43,0	470,2	20.217	736,8	31.684	11.467
Irrigated Maize Corn	6,0	434,5	2.607	2.473,7	14.842	12.235
Pineapple	5,0	1.436,2	7.181	2.842,1	14.211	7.030
Baby Squash	3,5	666,0	2.331	947,4	3.316	985
Sesame	2,0	267,4	535	397,9	796	261
Maize without Irrigation	32,0	438,2	14.023	447,4	16.842	2.819
Bean without Irrigation	18,0	435,9	7.847	789,5	15.632	7.785
TOTAL	134,5		66.339		123.375	57.036

Notes:
AC: Annual Cultivated Area in Manzanas
COSTO: Production Costs per Manzana, in USD
COSTO TOTAL: Production Costs in the Project Area, in USD
REVENUE: Revenue per manzana of crop, in USD
TOTAL INCOME: Revenue in Project Area, in USD
NET BENEFIT: Net Benefit in Project Area, in USD
Exchange Rate Applied: 19 Cordobas per US Dollar

Source: Pre-Feasibility Study

Value of Agricultural Production with Project

Considering the cultivated surfaces under irrigation of the two alternative scenarios, the following benefits from annual agricultural production have been established, considering the costs and benefits per manzana of crop.

Table 31 presents a relation of the production costs, revenues and benefits per manzana, expressed in American Dollars and multiplied by the cultivated areas in the scenarios of the project's situation.

Table 31: Value of the agricultural production with the Project, in US$

CROPS	AC	Cost Mzs	Total Cost	Revenue Mzs	Total Revenue	Net Benefit
Irrigated Bean	68,0	463,95	31.548	1.042,1	70.863	39.315
Irrigated Maize	96,0	470,17	45.136	736,8	70.737	25.600
Irrigated Maize Corn	12,0	434,53	5.214	2.473,7	29.684	24.470
Pineapple	6,0	1.436,16	8.617	2.842,1	17.053	8.436
Baby Squash	5,0	666,00	3.330	947,4	4.737	1.407
Sesame	4,0	267,42	1.070	397,9	1.592	522
Tomato	6,0	3.757,92	22.548	6.315,8	37.895	15.347
Bell Pepper	4,0	3.567,30	14.269	4.235,8	16.943	2.674

TOTAL	201,0		131.732		249.503	**117.771**

Notes:
AC: Annual Cultivated Area in Manzanas
COSTO: Production Costs per Manzana, in USD
COSTO TOTAL: Production Costs in the Project Area, in USD
REVENUE: Revenue per manzana of crop, in USD
TOTAL INCOME: Revenue in Project Area, in USD
NET BENEFIT: Net Benefit in Project Area, in USD
Exchange Rate Applied: 19 Cordobas per US Dollar

Source: Pre-Feasibility Study

The results on the indicated table show that the net revenue or benefit generated by agricultural production within the future irrigation area is US$ 117.771, which is a duplication of the current net benefits.

Project Costs

Project costs are divided into: costs for execution of works, costs for compensation, supervision and accompanying works, a budget of US$ 256,962.43 is the anticipated budget for execution of works.

The proposal for reducing consultation services costs is to hire a single company capable of providing work supervision and accompaniment during construction. To this end, it is anticipated to hire a national consulting company with experience in this type of service and work. The estimated budget is US$ 167.600,00.

The accompaniment and post construction service to support during the operation and implementation will be carried out by the Millennium Challenge Account through their Agricultural Operator. This service is of vital importance to consolidate the operation of a collective system in which water rights are recognized as well as the responsibility for maintenance of the system.

The total project cost, considering all the costs mentioned, reaches the sum of US$ 424,562.43.

Project Evaluation

In order to carry out the socio-economic assessment of the project, the private evaluation parameters were calculated using spreadsheets developed on Microsoft Excel. For its application, costs were generated and income from agricultural production under irrigation in situations with and without the project.

Likewise, the various costs of the project were considered, namely: investment cost for the construction of the proposed infrastructure and the costs of supervision and support services during the construction of the irrigation system.

An analysis of the profitability for a 20 year period, which is considered the minimum system lifetime, was carried out. The calculation details are presented in Annex 2 and the main results are presented in the table below.

Table 32: Results of Las Mercedes Project Evaluation

	Without Supervision	Total Cost

	Costs	Independent Administration
Cost, USD	256.962,43	424.562,43
TIRP	16,49	9,67
VANP, USD	215.571,44	60.386,26
C/B	1,27	1,06

The previous table evidences that for the scenarios taken into consideration, from the private point of view, the Project evaluation gives positive VAN values, the cost-benefit ratio above one, and the TIR values above 8%, reason for which the project is profitable and its execution is recommended.

Environmental Project Evaluation

During the formulation of the terms of reference for Las Mercedes Study, a possible Environmental B Categorization was considered which would require a specific environmental study.

Once the dimensions of the flow were derived, the irrigation areas involved and the type of works required, a new project D categorization was established pursuant to Decree 706/2006, for environmental evaluation of Nicaragua. Such category does not require an environmental management plan, just a project profile.

Since the environmental requirements of the Millennium Challenge Account are superior to those set forth in such decree, the project was assessed as category C, for which a management plan was formulated after identifying both the positive and negative impacts of the project.

Once the management plan was formulated, it was submitted to El Sauce Township for its evaluation and subsequent emission of the corresponding environmental license.

The management plan is detailed in chapter 8 of Las Mercedes Project Feasibility Study. It sets forth that the main negative impacts happen during the construction phase, reason for which the technical specifications should include the recommendations formulated by the environmental study. The contractor that executes the works should comply with these instructions and in turn, the works supervisor should demand them.

The project's feasibility is recognized in that most of the impacts to be generated are positive.

Legal Preparations Prior to Construction

Progress in Management

The designed water infrastructure is the collective use of water, so it is imperative that the project beneficiaries are organized to make efficient and sustainable use of both the resource and equipment and works.

Moreover, Nicaraguan water law requires every user to have a concession contract for use of the resource and concluded with the National Water Authority as well as to obtain permits for the construction itself. Below is a detailed progress report on legal preparation prior to construction.

Creation of the Irrigators' Association

After discussion with the leaders involved in the project and Las Mercedes irrigation project committee about the possible types of organization that could best accommodate, it was decided to establish a water users association, which shall consist of partners' irrigators and stockbreeders. The former have properties within the boundaries of irrigation and will win their right to irrigation, based on the work during the construction period. Farmers are residents of the lower watershed, those who rely on a significant number of livestock heads and will earn their right of access to water through their contribution during excavation works.

Annex 3 contains a copy of the constitution of Las Mercedes irrigation system. This copy has been extracted from the book of minutes of the Association, which provides a detailed list of all of the persons that make up the association, the association's elected Board of Directors, and the rights and obligations of each partner.

A detailed report of legal issues presented in a crosscutting document was delivered to the Millennium Challenge Account, by GFA Consulting, as a product of the analysis of Nicaraguan law and the characteristics of the projects involved.

Bylaws

From the discussion of alternatives of operation, recognition of the need to manage and generate shifts to optimize the use of the proposed infrastructure and to strengthen an organization that allows self-management and sustainability of the irrigation system. Bylaws of the Association have been agreed in a participatory manner with all association partners, which provide both processes and methodologies for conflict resolution, controls and compliance of obligations, etc.

A copy of the bylaws adopted by the Assembly of members of Las Mercedes System is presented in Annex 1, the rules of operation approved by the assembly is presented in Annex 4.

Legal Status

Part of the process of formation of the irrigators' association; correspond to obtaining a legal status so that the organization enjoys legal recognition and the possibility of relationships with public and private institutions as a collective group.

The crosscutting document for legal preparation prior to construction, made by GFA Consulting, evaluates the possibility to obtain such legal status and object of the association.

Annex 5 contains a copy of the municipal resolution that grants the legal status to Las Mercedes Irrigators' Association.

Pipeline Easement

A significant part of the infrastructure to be built must be places on private properties, reason for which it is necessary to rely on an authorization by the plot owners. Since the cooperative system will be lined along part of the existing canal, with some small modifications, a document to grant the easement has not been signed because this already established. The Central Las Mercedes System will require the corresponding authorization because it is a new system.

In view of the fact that purchase of such infrastructure easements is not included, the irrigators' association, represented by its president, has celebrated an easement contract with each of the plot owners for the proposed constructions.

Such easement commitment grants the permit and right of way to the construction of works, as well as the possibility of the partners to access these areas for maintenance. These easement agreements have not been monetized in the project due to the fact that these are voluntary assignments or local compensation agreements.

Annex 6 contains a copy of such commitment.

Letter of Bilateral Commitments

As the proposal is to jointly fund the works by the Millennium Challenge Account and the water use beneficiaries, the consultant proposes to sign a bilateral letter of commitment between both parties that established each party's responsibility.

This letter of commitment has been delivered to the Millennium Challenge Account for socialization with the beneficiaries. If the matters involved in such commitment have been already discussed by the consultant and the irrigators' association, the Millennium Challenge Account must perform a final socialization to underscore from the beginning of the construction process, compliance with the agreements.

Annex 7 contains a copy of the draft letter for the bilateral commitment, as well as a letter of request for support and funding by the beneficiaries addressed to the Millennium Challenge Account. Such note formalizes the local willingness to make counterpart contributions to the project.

Environmental Permit

The provisions set forth in Decree 76/2006, the project's environmental form, as well as the environmental management plan elaborated, has been remitted to the El Sauce Township for its review, evaluation and subsequent issuance of the environmental permit.

The project was publicly presented on September 03 in El Sauce Municipal Auditorium, where the project scope and the impacts that it will generate, as well as the formulated mitigation plan were presented.

In conformity with the project proposal, the Municipality issued an environmental backing, authorizing construction of the proposed works, under follow-up and monitoring of the proposed mitigation measures.

Annex 8 contains a copy of the environmental backing.

Construction Permit

For the construction of works in the municipality of El Sauce it is necessary to obtain a building permit from the land registry office. But having consulted with the municipal official about Las Mercedes Project, he mentioned that because the environmental permit was issued by the municipality, a new permit is not required.

For the temporary passageway and construction of access roads to building sites, a passageway commitment was entered into with the President of the Association and owners of affected parcels. Annex 8 contains this document.

Water Act

The new water law in the waters in Nicaragua, in force since March of this year, states that any water use must be authorized and be explicitly supported by a grant awarded by the National Water Authority (ANA), those conducting the exploitation.

To date, no such authority has been established, so it is not possible to make the grant application and not know with certainty, the steps and times that these procedures require. In the crosscutting legal document, the proposed recommendations for this grant should be processed afterwards. Anyway, the bilateral engagement letter establishes the liability of the partnership for that procedure.

Detailed Design of the Works

Design by Work

Catchment Works

The Central Las Mercedes intake will be placed on the right riverbank of Borbollón Hill with a catchment capacity of 30 liters per second. The selected sight is characterized for being a massif block in a narrow section, 2,70 m wide along the river.

The location of the water intake is located approximately 30 meters above the first irrigation plot.

Taking into account the slope on the riverbed and the anticipated catchment flow, a Tyrolean style receptacle (with a background grid) is proposed for use, whose calculation is presented in Annex 9, the methodology used is that proposed by Krochin. Verification of the incoming flow for normal conditions and in flood periods was performed.

The calculation for the settler and the spillway for surpluses are presented in the same attachment as for hydraulic calculation, following the methodology proposed by Hoogendam and Bottega.

For the rehabilitation of cooperatives water intake, the recommendations and methodology proposed by the National Irrigation Program (PRONAR) in Bolivia, through its publication on diversion dams and similar projects were taken into account.

Both the design data and results attained are contained in Annex 9.

To improve hydrodynamic conditions of the existing wall, partial demolition of the current structure is proposed.

The closing the stretch where a river lock gate was located completes the closure gate on the River; reshaping of the dam wall, improving the conditions of the ridge, and construction of a new outlet for the flow.

The section to complete the dam will be located in an alluvial bed. The used overflow of Las Mercedes River corresponds to a return period of 50 years.

The outlet for irrigation is at an elevation of 200.06 above sea level, and corresponds to an opening of 0.40 x 0.25 m, which limits the flow to the system to no more than 50 l / s. Still, the first meters of the channel have a surplus spillway and a series of gates that ensure controlled flow of water into the irrigation system.

For the protection of the intake, construction of upstream channeled walls of the outlet and a section of masonry with mortar at the foot of the jack are proposed. For relief of uplift loads, placement of distributed leaking holes is proposed.

The calculation of the sand trap and surplus outlets has been made following the recommendations of Hoogendam and Bottega (2006).

The metric calculations of the catchment work, complementary works and in the entire project are found in Annex 10.

Channels

Part of the existing main channels in the cooperative system is expected to be lined. The slope of the lined canal will follow the current channel slope. The analysis by sections is presented in Annex 9.

The canal walls and sill will be 0.20 m following recommendations from PRONAR Bolivia. The deigned channels have a capacity for driving 50 l/s.

To divert water to irrigation areas, placement of several gauges are considered, the calculation of which was performed using the WinFlume software, with which it has generated measurement rules, which are presented in the Annex about hydraulic calculation.

Pipeline Network

The distribution of water to the plots will be done through a network of PVC pressure pipes. Considering that the static pressure in the system, it contemplates the use of SDR 32.5 pipes in much of the network and SDR 26 pipes in the lowest part on the network.
To facilitate construction of the piping network, vertical and horizontal alignment has been considered so that the least number of elbows are needed. Taking into account the maximum deflection of 3° of deflection in the tubes, this must be absorbed at the junctions of the same. The plans present details of elbow location of 45 ° considered.

The use of air valves along the network to eliminate air pockets in high points and allow entry of air on the high points has been considered, and to allow entry of air while emptying.

With regard to water hammer effects due to the low speeds favored, in order to avoid loss of pressure, the maximum pressure resistance of the pipe was verified and widely exceeds the dynamic pressure and the effect of the water hammer.

The piping network will be loaded from a loading chamber at the upper part and will only exit through the hydrants of the network.

To cross Las Mercedes River, crossing under the river bed was opted, because the river in this sector is quite wide. The calculation and equations used are presented in Annex 11.

Special Works

Realignment of the high channel of the cooperative will need to cross over a stream, so an 8 m point aqueduct with a single span supported by two Cyclopean concrete blocks. Therefore, it will be necessary to build two road bridges over the canal; the site locations are presented in the corresponding drawings.

The delivery of water will be done through metal hydrants, fitted with shutoff valves to regulate flow and pressure in the mobile lines.

Project Budget

Basic Information for the Budget

Aggregate Quarry

Due to the low volume of aggregate that is required, it is proposed not to open lending banks. For collection of local materials it is recommended to purchase sand and gravel from local suppliers in El Sauce. The local shoal corresponds to Los Limones River, along the road to El Sauce - Achuapa. And the bank of gravel from the processing plant at the Telica junction, on the Leon - Chinandega road. This type of provision was considered for drawing up the list price per item.

Costs of Non-Local Materials for Work

Procurement of non-local materials (iron, nails, wood, etc.) will be made in the city of León. The costs of non-local materials and yields are presented on the price spreadsheet. These costs are estimated based on the identification of items of work according to the works of art on the type of work performed.

Mobilization costs

Qualified personnel must be hired in the city of León - Estelí and Chinandega, especially for the execution of works of art and others. Unqualified staff, for activities that do not fall as local input may be contracted in neighboring communities to the project area. The cost of mobilization has been incorporated in the budget.

Budget by Chapter

The budget for infrastructure was developed based on the metric calculations of the works executed and the price relationships set forth in Annex 12. The total amount for the construction of work amounts to two hundred fifty-six thousand nine hundred sixty-two 43/100 American Dollars (US$ 280,297.01).

Table 33: Budget for Las Mercedes Construction Works

Budget for Construction Works	Direct Costs Budget		Sales Price Budget	
	(C$)	(USD)	(C$)	(USD)
1- Preparation	**386.636,23**	**19.847,86**	**510.359,64**	**26.199,16**
2- Las Mercedes Intake Works	**86.010,91**	**4.415,34**	**113.534,40**	**5.828,25**
3- Central Las Mercedes Minor Works	**80.813,78**	**4.148,55**	**106.674,20**	**5.476,09**
Sand trap – Connection Canal	50.973,79	2.616,72	67.285,40	3.454,08
Loading Chamber	16.473,71	845,67	21.745,30	1.116,29
Pressure Breaker Chamber	13.366,29	686,15	17.643,50	905,72
4- Central Las Mercedes Distribution Network	**1.539.201,43**	**79.014,45**	**2.031.745,89**	**104.299,07**
Main Pipelines	1.481.851,68	76.070,41	1.956.044,22	100.412,95
Hydrants	57.349,75	2.944,03	75.701,67	3.886,12
5- Cooperative Intake Works	**196.294,82**	**10.076,74**	**259.109,17**	**13.301,29**
6.- Cooperative Minor Works	**201.428,27**	**10.340,26**	**265.885,33**	**13.649,14**
Sand trap	39.166,50	2.010,60	51.699,78	2.653,99
Vehicle Passage	41.943,22	2.153,14	55.365,04	2.842,15
Aqueduct	20.517,45	1.053,26	27.083,04	1.390,30
Irrigation Distributors	69.208,89	3.552,82	91.355,73	4.689,72
Main Distributors – Steps	30.592,22	1.570,44	40.381,73	2.072,98
7- Canal Network	**1.117.588,03**	**57.371,05**	**1.475.216,20**	**75.729,78**
8- Works for Stockbreeders and Laundromats	**184.169,28**	**9.454,28**	**243.103,45**	**12.479,64**
Stockbreeders – Reservoir	107.352,76	5.510,92	141.705,65	7.274,42
Cattle water troughs	59.358,46	3.047,15	78.353,16	4.022,24
Laundromats	17.458,06	896,20	23.044,64	1.182,99
TOTAL	**3.792.142,75**	**194.668,51**	**5.005.628,26**	**256.962,43**

To generate the sales Price budget, an overhead cost coefficient equal to 1,32 were used, according to the following details:

Table 34: Overhead Factor

General Expenses (%)	12,00
Profit (%)	10,00
Company Structure Costs (%)	10,00
Total %	32,00

Table 35 presents the project's funding structure.

Table 35: Budget and Items of Beneficiaries' Contribution

Budget for Construction of Works	Sales Price Budget (USD)	MCA Contribution (USD)	Community Contributions (USD)
1- Preparation	**26.199,16**	**26.199,16**	**0,00**
2- Las Mercedes Intake Works	**5.828,25**	**5.828,25**	**0,00**
3- Central Las Mercedes Minor Works	**5.476,09**	**5.440,05**	**36,04**
Sand trap – Connection Canal	3.454,08	3.454,08	0,00
Loading Chamber	1.116,29	1.116,29	0,00
Pressure Breaker Chamber	905,72	869,68	36,04
4- Central Las Mercedes Distribution Network	**104.299,07**	**88.740,01**	**15.559,06**
Main Pipelines	100.412,95	84.853,88	15.559,06
Hydrants	3.886,12	3.886,12	0,00
5- Cooperative Intake Works	**13.301,29**	**13.073,72**	**227,57**
6.- Cooperative Minor Works	**13.649,14**	**13.290,38**	**358,76**
Sand trap	2.653,99	2.556,58	97,41
Vehicle Passage	2.842,15	2.792,60	49,55
Aqueduct	1.390,30	1.374,93	15,37
Irrigation Distributors	4.689,72	4.587,96	101,76
Main Distributors – Steps	2.072,98	1.978,31	94,67
7- Canal Network	**75.729,78**	**66.370,13**	**9.359,66**
8- Works for Stockbreeders and Laundromats	**12.479,64**	**12.156,19**	**323,45**
Stockbreeders – Reservoir	7.274,42	7.075,06	199,36
Cattle water troughs	4.022,24	3.932,79	89,45
Laundromats	1.182,99	1.148,34	34,65
TOTAL CONSTRUCTION BUDGET	**256.962,43**	**231.097,89**	**25.864,55**

The table shows that 10% of total construction costs will be contributed by the beneficiaries in labor, both during excavation for laying the pipeline, excavation and profiling for the construction of canals and in tamped filling works on trenches and outer sides of the channel.

General Budget

For the proposed construction on the project, in addition to the cost of works, recruitment of a consultant in charge of construction supervision is required as well as a support team to support users in complying as counterparts. Annex 13 presents the estimated cost for such consulting services.

The total project budget is detailed on Table 36.

Table 36: Las Mercedes Irrigation Project Funding Structure

Heading	Amount USD	MCA Contribution USD	Contributions from Beneficiaries USD
Investment	256.962,43	231.097,89	25.864,55
Supervision and Accompaniment	167.600,00	167.600,00	0,00
TOTAL	424.562,43	398.697,89	25.864,55

Unit Prices

Annex 14 exhibits detailed Price relations.

Operation and Maintenance Budget

Operation and maintenance costs are estimated at US$ 4,386, costs that user will contribute in daily wages and annual monetary contributions to operate and maintain the systems.

Project Execution

Strategy for Execution of Works

The method of implementation of the works is by hiring a general contractor specializing in the implementation of water projects and a consultant with experience in supervision and monitoring of waterworks and irrigation.

The tender for the work shall provide for the commencement of work in January, in order to take advantage of the dry season and less water in the river for the corresponding construction works.

The experience required to supervise the works shall likewise include both the experience in supervision of civil and hydraulic works, such as intakes, structures, pressure pipe networks and leading channels.

Moreover, the procuring entity must employ a Works Prosecutor, who shall be a civil engineer with extensive experience in civil and hydraulic works, to be the person designated to manage and monitor the contracts of the contracting and supervision companies, ensuring full compliance for the sake of the project. The Works Prosecutor will coordinate all necessary aspects of both contracts with the contracting entity, between the contractor and supervision companies and between these companies and local authorities, institutions and the general public.

Construction Process

The construction schedule has been adapted for the construction of all the works in a period of 160 calendar days, taking into account the construction during the dry period.

To expedite the construction process the contractor company will, upon redesign of the work, start work in parallel on both the network of pipes that go underground, as well as the construction of inlets and channels.

Excavation in semi-hardened and regular fields for piping and channels will be borne by the beneficiaries; this activity cannot be met by the contractor without posing a heavy load during the first months of the contract. Once trenches are built and pipeline bedding is made, the assembly process for the network is pretty fast. Construction of canals is expected to be connected with the excavation and preparation of the excavation. In order to meet the expected periods, at least two teams responsible for canal lining are anticipated.

Due to the fact that the riverbeds to work do not dry up throughout the year, diversion and water control for the construction of intakes is anticipated. We recommend the use of pipes for the diversion. The biggest bottleneck will be to identify the speed with which beneficiaries can dig trenches to form the pipe network, so it is recommended to start this work immediately upon completion of the redesign of work.

To ensure the implementation on time and according to the established deadlines, it is important that the Contractor submits a construction proposal for each prospective structure and that it be approved by the project supervision and prosecutor.

Community contribution

Las Mercedes Association of Irrigators has jointly established a contribution of 20 per acre to irrigate wages.

To avoid an overload of work of the beneficiaries, who in addition to the wages to be provided in the project must work to support their families, has set aside 2 to 3 days maximum per week that each member can work on the project. It is the responsibility of the support team to coordinate these activities.

Technical Specifications

The technical specifications for construction are in Annex 15. These instructions are suitable for Las Mercedes Irrigation Project. Compliance and control is the responsibility of project monitoring and prosecution.

Terms of Reference for Supervision and support

The terms of reference for monitoring services and project support are presented in Annex 16. It is the responsibility of the prosecutor's supervision and control of work by the supervision and guidance.

Implementation schedule

The implementation schedule of the works for Las Mercedes Irrigation Project is expected to be 160 calendar days, assuming that the works will begin during the first days of January 2009, and taking advantage of the dry period.

Annex 17 shows the tentative schedule of execution of works, considering average yields for major activities in the volume of work and the simultaneous execution of different activities, thus requiring a large number of workers throughout construction. The estimated the amount of the minimum equipment necessary for all the work, is in accordance with the details presented in Table 37.

Table 37: Detail of Minimum Equipment Required

Detail	Unit	Amount
Blender Spin 300 l	c/u	2
Leaping Compactor	c/u	2
Concrete Vibrators	c/u	2
Dump Truck 6 m^3	c/u	2
Water Pump 3”	c/u	1
Compressor	c/u	1
Jackhammers	c/u	1
Truck 4 x 4	c/u	1
Electricity Generator	c/u	2

Plans

For the construction works, plans and detail are submitted for the construction of each work. All of these plans are presented in Annex 18. Each of them details construction aspects to be considered.

ANNEX 4

Report on the Studies and Designs of Las Mercedes and Salale Irrigation Systems

1. Documents provided for each irrigation system

1.1-Technical Documents

1.1.1-Hydrology

1.1.2-Topography

1.1.3.-Geology

1.1.4- Geometric Design

1.1.5- Structural Calculus

1.1.6- PDF Plans (Blueprints)

1.1.7- Calculation

1.1.8- Budget Estimates for Works and Unit Price Analysis

1.1.9- Financial-Economic Evaluation

1.1.10- Technical Specifications for Construction

1.1.11- Base Document for Irrigation System Management

1.1.12- Consolidated Final Report

1.2- Institutional Documents

1.2.1- Community

1.2.1.1- Minutes of the Incorporation of the Association of Irrigators

1.2.1.2- Bylaws of the Association of Irrigators

1.2.1.3- Minutes of the General Assembly of the Association of Irrigators for Operation of the Irrigation System

1.2.1.4- Table of Beneficiaries

1.2.2-Municipal

1.2.2.1- Certification of the Legal Status of the Association of Irrigators

1.2.2.2- Municipal Environmental Backing for the Project Works

2-Documentation Analysis

2.1 Technical Documents

2.1.1 Hydrology

The documentation for hydrological, pluviometer and flow data of the water sources for the project is considered to be well processed for completion of a series of consistent and representative data of the watersheds included in the study, as well as the weather data to process the water offer and demand, and to determine the water balance for the systems.

2.1.2- Topography

Selection of the sites for the reservoirs and water intakes was carried out together with the users of the selected sources, and the topography surveys are consistent with the areas used for construction of works: reservoir and intake areas, and the route for tracing the paths for channels and pipelines, as well as complementary works are indicated in

the table with the coordinates for the surveyed points, at the intake sites and the distribution path: channels, pipelines and complementary works, sufficient for the corresponding reconsideration.

2.1.3-Geology

According to the geological studies, the selected areas for the work were typified in terms of their origin of formation, types of materials, and the absence of geological or volcanic risks.

2.1.4- Design

Review of the corresponding technical documents for the structural design of the works: structural calculations, calculation of the amount of work to be executed, estimation of unit prices and general cost budgets, are consistent with good engineering practices for projects of this nature, and are complete.

2.1.5- Plans (Blueprints)

In relation to the submitted plans (blueprints), in the review of the Salale Project plans (blueprints), the blueprint numbered as 008 was repeated as 009, because the latter is lacking a stretch of pipelines, which must be requested from the MCA-N, or the design company.

On the other hand, the company to be hired for execution of works should receive the plans (blueprints) in DWG CAD Format so that they can update them and include construction modifications and adjustments, and finally elaborate the plans (blueprints) "as built".

2.1.6-Budgets for Works

Budgets for works have been updated to take into account both inflation during the period (approximately 22.57%), and sliding national currency (Cordobas) based on dollars during the same period (19.48/21.7). Consequently, the estimation of the donor's contribution for construction in Las Mercedes rises from US$231,097.89 to US$257,464.52 and in Salale from US$260,170.83 to US$288,850.38.

In terms of the oversight and monitoring budgets, modifications due to inflation and sliding currency were not made, considering that although during the period minimum salaries have increased by approximately 14%, estimations in dollars for the headings under this concept are very comfortable. An important consideration is the probability that the two works will be executed during the same period: the first dry season after the project begins. This will allow consolidation of the oversight and monitoring work in a single contract, estimated at US$ 189,900, instead of US$ 167,600 for Las Mercedes and US$ 169,200 for another oversight and monitoring contract for construction in Salale.

Memoirs of the calculation are included in the attached Excel Book.

2.1.7- Financial – Economic Evaluation

The economic and financial evaluation performed by the Farmer Benefit method, which compares the output of major items of agricultural production in project areas, and its price in the without-project and with-project situations, in this case, including the incremental production under irrigation, and also the incremental irrigated manzanas or blocks.

The analysis of the indicators (TIR) IRR, (VAN) NPV and C/B indicators surmount the minimum values required: IRR greater than 8% and positive values for NPV and benefit-cost ratio greater than the unit, according to the relevant Annexes[3].

2.1.8- Technical Specifications

The technical specification documents for construction works are revised, which indicates the conditions to be met for the concepts of works referred to therein, these should be complemented by NIC 2000 specifications for roads, as these include concepts for similar works, and other international standards commonly used in engineering (distribution pipes, concrete channels, welds in steel structures, etc.); in some cases, the manufacturer's instructions should be followed (if PVC pipelines).

The country does not have special specifications for these types of works.

[3]View folders Intakes MCA/Mercedes /Annexes/Annex 7.3 Economic and Financial Evaluation; and Intakes MCA/ Salale /Annexes /Annex 7.4 Financial and Economic Evaluation

From the engineering point of view, the submitted documentation allows for construction of works as soon as these are contracted, and that the necessary adjustments according to site conditions, will be defined by the supervisor and the contractor, as deemed necessary.

2.1.9- Terms of Reference

In relation to the terms of reference for the oversight and monitoring contract, these must be modified according to the contracting agency; in the same manner, the scope of the support in relation to terms should also be clarified since there are divergences that would reflect in costs. This support should *begin at the beginning of the construction of works, and continue through a sufficient period of time to guarantee that beneficiaries learn of the irrigation systems' operation and management, as well adaptation to its management,* which is estimated at 6 months for construction and 4 months of operation, for a total support period of 10 months, as shown in the cost tables.

It is recommended that the tender documents should make clear the *maximum amount available* for the project construction, the designer should recommend it to be lump sum (fixed), my recommendation is that it should be by quantity of work executed and unit prices, as this allows for variations in contracts of such amounts can be high risk for the contractor if they are not recognized, for the Oversight and Monitoring it is also recommended to inform the bidders about the *maximum amount available*.

2.2-Institutional Documents

The documents related to the *operation and sustainability* of the system have been reviewed, verifying that the necessary steps have been taken to satisfy the condition of *participation and commitment of the direct beneficiaries of works, and national and local institutions that promote the development and mitigation of food* vulnerabilities and adaptation to climate change impacts.

These documents were prepared during the *project definition phase* and due to a standstill of actions for immediate construction, implementation and operation was declining, raising the need for its revival in the minds of beneficiaries.

Some documents should be reviewed from a legal standpoint to ensure the permanence of commitments, regardless of the variability of the owners or members of the Associations of Irrigators.

ANNEX 5

Menu of production practices for adaptation to climate variability and change.

In the municipality of intervention, agricultural production, stockbreeding and forestry are performed with low yield production systems and with very strong negative impacts on the environment. These have deteriorated the balance of the ecosystems, soil productivity, water availability and the richness of the biodiversity.

The proposed models are already being implemented in some municipalities attended by MST-MARENA and are geared to revert the environmental issues, particularly land deterioration, and toward a substantial increase in agricultural production and livestock as well as forestry. These were designed based on the lessons learnt by farmers and local technical experts, during implementation of several projects by local NGOs and government institutions; in addition, the knowledge of experts and specialists from research centers (INTA, UNA, CIRA) have been incorporated. The models will contribute to the creation of a new production culture that is environmentally healthy and with good returns. The models will also contribute to improving economic and ecological conditions for these beneficiary municipalities.

Out of 9 models that were identified, 5 were selected for implementation: 2 agro-forestry (basic grains with trees and basic grains on improved alleys, 1 silvopastoral (shrubby slopes), and 2 forestry (Protection of the Water Hole and Forest Gallery Areas for Potential Forestry Use and Sustainable Forestry Management of the Broadleaf Dry Forest).

AGRO-FORESTRY SYSTEM:

The Agro-forestry System consists in associating agricultural crops (maize, beans, sorghum) with valuable timber species obtained by natural regeneration or established by direct seeding, combined with physical works and agronomic soil and water conservation on sloping land.

The System is an intensive land management in the short and medium term, depending on each of the established components. Management of the agricultural component will aim to increase production of basic grains through the association with green fertilizers, crop rotation, incorporation of organic materials, integrated pest management (IPM) and non-burning. The forest management component will aim to regulate the shadow, ensuring protection and improvement of the microclimate required by the main crop by pruning and desuckering scattered trees and windbreaks. Management of the physical works component for soil conservation will be aimed at ensuring their functionality through their maintenance.

SILVOPASTORAL SYSTEM

This consists in establishing 3 ecological tiers, using grasses; shrubs and superior trees, ensuring the predominance of legumes to meet the objective of producing good protein capacity food for livestock in the summer, in addition to producing foliage to improve soil fertility, reduce erosion and as an added benefit, the control of weeds (Montagnini et al, 1992; IRENA, 1993b).

As an integral part of these systems multi-purpose species areas will be established to improve the family diet, animal feeding and ecology of the area. To this end, grafted fruit plants and commercial timber will be promoted, while also providing each family with materials and technical assistance. In developing these actions, contribution of farmers with their labor will be of vital importance.

PROTECTION OF WATER SOURCES AND REHABILITATION OF THE RIPARIAN FOREST

This component will provide protection to the area with riparian forests or river banks and streams. Therefore, the protection of springs and streams is a high priority for conservation, restoration and sustainable management in the entire drainage network of the micro watershed.

The project will increase the enrichment activities of degraded forests, management of natural regeneration and increasing the areas for the recovery of natural forests, allowing incremental development and productivity of forest and agricultural resources by implementing new methodologies and techniques for utilization of forest resources, with the implementation of new production alternatives based on the economic value of natural forests to improve their quality of life.

FOREST MANAGEMENT

Planning is underway for the development of general management plans where the beneficiary population will engage in the development of forestry treatments, no burning, labor and the prevention, control and proper management of forest fires.

It will strengthen forest fire brigades and to identify and understand the potential of the area with the aim of taking the first steps to run a water PSA.

As a result, the municipalities will improve their rate of climate change adaptation and appropriation of a new productive culture environmentally friendly and with natural resources, strengthening local capacities, with the participation of all sectors of the population, led by the municipal government. Furthermore, the formation of strategic alliances between institutions programs and projects to meet common goals.

COMPONENTS

Protection of water sources and rehabilitation of forest galleries

The protection of water sources and rehabilitation of forest galleries is a system that will be implemented on farms, which will allow for recovery, maintenance and increment of the protection functions of the natural forest surrounding the existing water hole in the communities and forests with high landslide risks.

This system will take into consideration the areas for potential forest use with and without the forest and forests with fragmented galleries.

FOREST MANAGEMENT

The forest management component will be implemented with farmers by performing low intensity forest management; therefore, this requires a search for innovative mechanisms where environmental and financial sustainability in the mid and long term, which hinders change in the use of soil for agricultural activities with the search and identification of clients demanding Payment for Environmental Services (PES) (Water).

The beneficiary population will engage in no burning, its workforce and prevention, control and proper management of forest fires. In other words, both the conservation, which is the proper care and protection of the forest, will be a direct responsibility for the beneficiaries of the project. By investing time, labor and replicas of experiences, they will contribute to justify the investment in environmental compensation funds, investments in reforestation and restoration in areas where appropriate.

Characteristics of potential forestry use and management proposals

<table>
<tr><th rowspan="2">Characteristics of potential forest use</th><th colspan="3">Management Proposal</th></tr>
<tr><th>With forest</th><th>Without forest</th><th>With forest gallery</th></tr>
<tr><td>Water holes and human consumption water wells</td><td rowspan="2">Natural regeneration management + protection against forest fires + forestry management plan (forestry treatments)</td><td rowspan="2">Promotion of natural regeneration and/or enrichment + protection against forest fires and for livestock (rounds, fencing, land clearing)</td><td></td></tr>
<tr><td>Landslide risk areas and protection of infrastructure</td><td>Enrichment + protection (fencing)</td></tr>
</table>

Main soil and water conservation works

Type of work/erosion	Erosion gullies and channels	Sheet erosion	Landslides
Conservation Works	Stone dikes (4/ha) inflammable dikes (4/ha) Dead Barriers	Dead barriers, infiltration chambers, individual terraces	Contention Walls Bench terraces

Advantages and disadvantages of establishing forest management

Advantages	Disadvantages
Secondary forests have high regeneration capacity	A good part of the forests have non-commercial lumber potential
Management allows for easy and fast soil coverage	Regeneration management requires time and patience
Reduced soil erosion based on its establishment	Promotion of regeneration is required for at least five years
Captura de carbono en la biomasa como en el suelo	Earnings are low but constant
Does not require many investments per area unit	
It can be simultaneously performed with agricultural activities	
It improves the landscape and increases the value of the land in the long term Payment for environmental services	

The advantages that the model offers require a waiting period, therefore exclusive use of the land for forestry purposes.

Advantages and disadvantages of re-establishing riparian forest

Advantages	Disadvantages
Conservation and regulation of the water regime and river and stream flow	Access to the area under protection is restricted
More water availability in the summer for human and animal consumption	In most cases, it requires a collective decision
Many lands without a forest have high regeneration capacity	This requires fencing to protect against livestock and fire
Its protection allows easy and fast soil coverage	The initial investment is important, compared with agricultural investment
Reduction of soil erosion once coverage is recovered	It requires exclusive use as a forestry area
Capture carbon in the biomass and in the soil	
It does not require much investment per area unit	
In the mid-term, improves the landscape and increases the value of the land	

The structure of the forestry system seeks to maintain and increase the reload of the aquifers through changes in practices for land use, with activities to fence the forest, clean sites, build rounds, pruning, and land clearing and thinning in the forest, physical works for soil and water conservation, such as: dikes, a small general inventory of the flora and fauna, and surveillance of the sites to prevent forest fires through the organization of brigades against forest fires.

Agro-Forestry System

Basic Grain Cultivation with Scattered Trees

The basic grain production system with scattered trees consists of associating agricultural crops (maize, beans, and sorghum) with valuable timber species obtained by natural regeneration or established by direct planting, combining with physical and agronomic works for soil and water conservation on sloping lands.

This model's structure has 3 components: agriculture, forestry and soil and water conservation works.

The basic grain system with scattered trees will be formed by the following elements: crops to be established (green fertilizers or basic grains during the first season crops and basic grains in the second season) in association with valuable timber species.

1. Innovative practices
2. Complementary practices

It is designed in strips along the contour where the main crops alternate (maize, sorghum, beans) with green fertilizer, so as to allow rotation of first and second season crops. This leaves scattered trees between the strips of crops and green fertilizer, while maintenance works are arranged according to the slope and contour. Finally windbreaks will be established in a single block on the edge of the plot, according to wind direction, as shown in the Figure.

For the agricultural component, cultivating the main crops in agricultural association, will be done with handspikes, during the first season crop (May) independent crops will be planted (maize, sorghum, red beans and black beans), and during the second season crops beans, maize, sorghum and corn or a combination thereof will be established.

For the forestry component it is suggested that for the first season, the scattered trees through natural regeneration should be selected, such as: Laurel, Cedar, Mahogany, Genizaro, White Guanacaste, and in the second season, windbreaks should be established with 3 rows of trees and in three rolls (Melina, Acacia, Olive, Laurel, Calf Guácimo, Tigüilote and Eucalyptus).

For Soil and Water Conservation, the physical works will be built (curb terraces or dead barriers, infiltration chambers, stone dikes and living barriers) at the initial establishment of the system, before the first rains, while the agricultural works (green fertilizer and hedgerows) will be installed with the rainy season (first and/or last season).

Components, elements and techniques of the basic grains system with scattered trees

Component	Parameters	Association during First Season			Association during Second Season		
Agricultural	Species	Beans	Sorghum	Maize	Maize	Sorghum	Beans
	Association	Maize + Sorghum, Maize + Beans, Sorghum + Beans, Beans			Maize + Sorghum, Maize + Beans, Sorghum + Beans, Beans		
	Varieties	INTA Precocious INTA Red	Corn Creole Pinolero 1, Tortillero Precocious	NBS Creole Pujagua	NB-6, NBS, Creole Pujagua Tlayoli. NB Nutrinta	Corn Creole Pinolero 1, Tortillero Precocious	INTA Precocious INTA Red
	Arrangement	In separate strips and with crop rotation, following the contour					
Forestry	Parameters	Natural Regeneration (*)					
Scattered Trees	Species	Laurel, Cedar, Mahogany, Genízaro, White Guanacaste, Aripin (White Brazil) , Pochote					
	Densities	200-250 trees/ha.					
	Arrangement	Scattered					
Windbreaks	Species				Nim-Laurel-Yellow Acacia – Eucalyptus		
	Density				100 to 150 trees per 100 lineal meters		
	Arrangement				3 rows in three rows		
Soil and Water Conservation Works	Parameters						
Contour Terraces or Dead Barriers	Dimensions	0.70 m x 0.70 m and 100 m length					
	Arrangement	On contours and strengthened with shrubs					
Infiltration Chambers	Dimensions	1.50 m length x 1.00 m width and 1.00 m depth					
	Arrangement	Each terrace will be built					
Stone Dikes	Dimensions	1.5 m height and 1 m base or thickness and the length or crosscutting section between 2 to 3 m.					
	Arrangement	The drains and gullies of the plot are placed					
Dikes with Living Barriers	Dimensions	Stakes of Espadillo, black wood, Piñuela and Tigüilote. 15 to 30 cm. in diameter and 2.0 m long (including what is going to enter = 1 m)					
	Arrangement	These are placed in plot drains and ditches					
Agricultural Works	Species in Green Fertilizer	Mungo, Alacin, Canavalia, and Velvet plants with all the crops and associations, except with first and second season beans					
	Arrangement	In separate strips with crop rotation following the contour level					
	Species on Live Barriers	Espadillo, Sugarcane, Gandul, Pineapple, Lemmon Grass and Valerian					
	Arrangement	On contours before the contour terrace or dead barrier					

Vegetation to be used for setting up the system:

Component	Materials to be employed	Amounts to be used
Agriculture		
Beans (kg/ha)	Seeds	30 – 40
Maize (kg/ha)	Seeds	20 – 30
Sorghum (kg/ha)	Seeds	15 – 20
Forestry		
Scattered Trees	Complete plant in bag	200 to 250 trees/ha
Windbreaks	Complete plant in bag	100 to 150 trees in 100 lineal meters
Conservation Works		
Live Barrier Dikes	Stakes	15 - 20 units/dike
Green Fertilizer (kg/ha)	Seeds	30 – 40
Live Barriers (kg/ha)	Seeds	38

Advantages and disadvantages of the "Basic Grains with Scattered Trees" production model

Advantages	Disadvantages
Improved soil conservation through control of erosion and maintenance or improved fertility	Requires much investment per area unit
Firewood production and other forestry products	Management of the model requires time and patience on the part of the farmer
Food production for self-consumption and for local market sales as well as for exports	These models require promotion at least during the first five years
Carbon capture in the biomass and in soils	Requires much labor per area unit
Agricultural and forestry activities can be performed simultaneously	
In the mid-term, improve the landscape and increase land value	
Improve socioeconomic conditions in rural areas	
Climate effects toned down	
More moderate micro-climate	
Maintains soil structure and fertility	
Helps to recover degraded soils	
More production and better quality harvests in marginal environments	

Source: CATIE 1999. Agro-Forestry Teaching Module

Cultivation of basic grains in improved pathways

This system will consist of the association of agricultural crops (maize, beans, sorghum and sesame), with timber species set out in rows, forming alleys, with the combination of Soil and Water Conservation works on sloping lands.

For this system, the strategy will be to provide basic grain seeds only in the first planting season, turning production into a revolving fund where 80% of basic grain seeds will be delivered, with a commitment by the farmer to return 100% of seeds received to the seed bank that manages the local economic development office (ODEL) of the Municipal Government, to try to guarantee seeds for other farmers and for themselves, for the following years.

The Basic Grains System in improved alleys will be formed by the following elements:

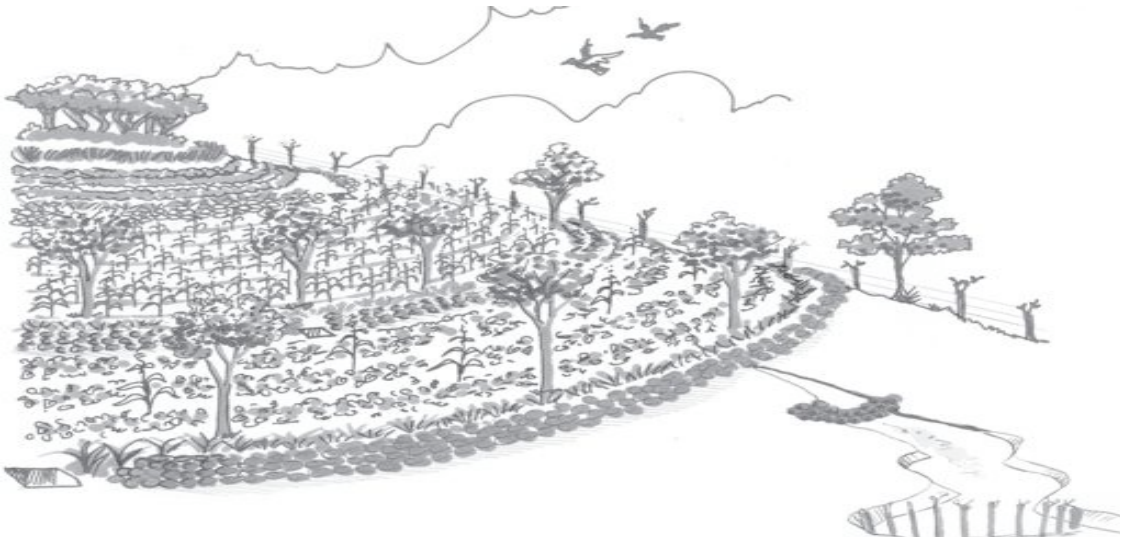
- Crops to be established (green fertilizer during the first season + basic grains during the last)
- Construction of pathways demarcated by barriers or contour terraces
- Innovative practices
- Complementary practices

For the agricultural component planting of major crops and agricultural associations will be made with handspikes in the first season (May); crops will be planted separately (corn, sorghum, red beans and black beans) and for the second season, Maize, Sorghum and Corn, or a combination thereof.

For the forestry component it is suggested that during the first planting season, planting live fences with 1 row of woody trees in a linear fashion (Tigüilote, Acacia, Sardinillo, Black Wood, and Neem) in the perimeter of the plot.

For the component of Soil and Water Conservation Works, physical works will be built (contour terraces or dead barriers, infiltration chambers, stone dikes and live barriers) at initial establishment of the model, before the first rains, while agricultural works (green fertilizer and hedgerows) will be installed with the season (first and/or last). Live barriers will also be established with Valerian and Lemon Grass, in order to protect the conservation work.

Graphic Illustration of the Basic Grains Model in Improved Pathways



Design and Arrangement of the Basic Grains Sub-System in Improved Pathways

Element	Model	Crop Phases						
		Association in First Season			Association in Second Season			
Agricultural Association	Species	Beans	Sorghum	Maize	Maize	Sorghum	Beans	Sesame
	Association	Maize + Sorghum, Maize + Beans, Beans, Sesame			Maize + Sorghum, Maize + Beans, Beans, Sesame			
	Varieties	Wine Red Costa Rican Red INTA Cinnamon Estelí 90, H46	Corn Creole Pinolero	NB-6, Creole Pujagu	NB-6, Creole Pujagua	Corn Creole Pinolero	Wine Red Costa Rican Red INTA Cinnamon Estelí 90, H46	ICTA-R Mexican Nicarao
	Arrangement	In separate rows and with crop rotation, following the contours						
Forestry Component	Model				Plantation			
Forestry Rows	Species				Black Wood, Leucaena, Acacia, Marango, Vainillo			
	Densities				300-400 trees/ha			
	Arrangement				In rows, following the contours			
Establishment of Live Fences	Species	Nim, Leucaena, Acacia, Sardinillo, Marango, Guázimo de ternero, Tigüilote and Vainillo						
	Density	35 to 50 trees in 100 lineal meters						
	Arrangement	Lineal along plot perimeter						
Soil Conservation Works	Parameters							
Contour Terraces or Dead Barriers	Dimensions	0.70 m x 0.70 m and 100 m length						
	Arrangement	Following the contours and strengthened with shrubs						
Infiltration Chamber	Dimensions	1.5 m long, 1.0 m wide and 1.0 m deep						
	Arrangement	They will be built on each terrace (7-14)						
Stone Dikes	Dimensions	1.5 m height,1 m base and the length or crosscutting section between 2 to 3 m.						
	Arrangement	They are placed in plot drains and gullies						
Live Barrier Dikes	Dimensions	15 to 30 cm diameter and 2.0 m length (includes the part that will be introduced = 1 m) with stakes of Espadillo, Madero negro, Tigüilote and Piñuela.						
	Arrangement	Se ubican en los drenajes y cárcavas de la parcela.						
Agricultural Works	Species in Green Fertilizer	Mungo, Alacin, Canavalia, Terciopelo with all of the crops and associations						
	Arrangement	In separate strips, with crop rotation and following the contours						
	Species in Live Barriers	Espadillo, Sugarcane, Gandul, Pineapple, Lemmon Grass and Valerian						
	Arrangement	In contours before the contour terrace or dead barrier						

Vegetation Material to be used in Establishing the System

Component	Materials to be employed	Amounts to be used
Agriculture		
Beans (kg/ha)	Seeds	30 – 40
Maize (kg/ha)	Seeds	20 – 30
Sorghum (kg/ha)	Seeds	15 – 20
Sesame (kg/ha)	Seeds	3 - 4
Forestry		
Forest Rows	Complete plant in a bag	300-400 Trees/ha
Live Fences	Stakes	150 to 200 Units
Conservation Works		
Live Barrier Dikes	Stakes	10 - 20 Units/dike
Green Fertilizer (kg/ha)	Seeds	30 – 40
Live Barriers (kg/ha)	Seeds	38

Advantages and Disadvantages of the "Basic Grains in Improved Pathways" Production Model

Advantages	Disadvantages
Produce considerable amounts of biomass trees, agricultural crop cuttings and foliage from green fertilizer	Requires much investment due to the scheduled activities in a specific area
Produce firewood for cooking food and for trade, in addition to providing other forestry products	The management model requires a budget, time and patience on the part of the stakeholders (farmers)
Produce basic grains that guarantee food security (self-consumption) for farmers; surplus is traded in the local market or exports, which represents an improvement in the standard of living of the inhabitants in these seven municipalities	This model lacks adaptability by the farmer, thus requiring promotion for these models at least with the introduction of this project in the seven municipalities during these upcoming five years
The biomass from trees, the cuttings from agricultural crops and foliage from green fertilizers, contributes toward erosion control, maintains and improves soil fertility	As of its implementation, the model requires labor with initiative and dedication
This model can be set up simultaneously, beginning with the establishment of soil conservation works after the forestry and agricultural component	Lack of real monitoring of the involved activities in establishing these agro-forestry models by the interested organizations and institutions
Improve socioeconomic conditions for farmers in these seven municipalities	Capacity building (strengthening) are missing so that these models guarantee their sustainability
In the short term, improves the landscape in the area and substantially increases the value of the land	
Improves edaphoclimatic conditions in the area	
The micro climate in the area becomes more acceptable and healthier for the population	
The establishment of this model will contribute to maintaining the structure and fertility of the soils	
Helps to recover degraded soils (productivity)	
Improves production and quality of harvests in marginal environments	
Captures carbon in the biomass and in soils	

SILVOPASTORAL SYSTEM

Components of the Silvopastoral System

The following table describes the practices for each component of the silvopastoral model (pastures, agriculture, forestry, conservation Works) to be implemented; in some cases, these are traditional Works that farmers develop by component.-

Components and Techniques of the Silvopastoral Model

Component	Sustainable Practices					Contribution
Pastures	Planting pastures (Angleton, Gamba, Taiwan, King grass, Brachiaria)	Maintenance of grazing lands (re-planting, fertilization, etc.)	Integrated MIP Pest Management and no-burning (fire cutoff rounds)	Cuts, mixture and stockpiles of fodder ((Gramineae + Leguminosea)	Dosage of supplementary feed (fodder)	Improved feeding diet for livestock and increased milk and beef production.
Agriculture	Crop planting (maize and sorghum) and leguminous creepers (Canavalia and Velvet)	Crop maintenance and leguminous creepers	Integrated pest management and no-burning (fire cutoff rounds)	Manual harvesting of padding (50days) and of creeping leguminous plants		
Forestry	Natural regeneration or shrubs or scattered trees	Maintenance of shrubs and scattered trees	Preventive surveillance for external fire control and against fires	Harvest and gathering of fruit and fodder (fodder cutting and fruit crushing)	Dosage of natural concentrate or extract	Income generation derived from forester management – reduction of soil degradation
Conservation Works	Lagoons with filters	Infiltration chambers	Stone or live barrier dikes	Maintenance of works	Reconstruction of works	

Source: Adapted from the Final Report Document of the MST-UNDP Investment Project, 2005

Pasture Component

Improved pastures will be set up such as, Angleton, Gamba, King Grass, Brachiaria, and Taiwan to guarantee feed for the livestock during the summer period and increase family income by selling seeds. In addition, the stockbreeder population will have better nutrition opportunities with the rest of the components incorporated in the model.

This model includes the establishment of agricultural crops for the elaboration of improved padding; it is cut at 50 days (flowering), it is extended over the plot of land (3 to 4 days) for uniform drying and it is mixed with grasses (Angleton, Gamba, etc) to feed the farmer's livestock.

Planting has been established during the last season (August) in order to have feed during the summer; planting is done with handspikes, without ox plowing or machinery; integrated pest management is performed with preventive measures.

Forestry Component

It is composed of a floor scattered shrub species, obtained by natural regeneration or direct seeding. The recommended species are Marango, Black Wood, Tigüilote, and Guácimo, in addition to the following timber floor with wide treetops scattered like Genizaro, Ear Guanacaste, Wild Carao, Quebracho, Tamarindillo, Chilamate and Mango.

Conservation Works

The expected results in the construction and maintenance of conservation works and the combination of these techniques, erosion control and afforestation, with multiple-use approaches, can retrieve in a sustainable way degraded and impoverished rural areas (CONAF / JICA 1998, Manual Erosion Control.)

Storm Water Infiltration Ditches

These will be built with dimensions 2 m wide, 1 meter deep and length according to ground conditions. These areas will be established in drainage depressions (not streams) to retain and store water from storm water runoff. The goal is to help reduce soil erosion, increase biomass production for livestock fodder, improving soil moisture conditions and accelerate the growth of plants in their vicinity.

Dead Barriers

These are built with stones from the location and following the contour line with a width according to the slope (a minimum of 70 cm base by 70 cm high); the purpose is to reduce surface runoff, encourage infiltration and retention of eroded soil.

Stone Dikes

These are built with stones from the location and settled in drains and gullies of the plot, strong structure with dimensions of 1.5 m base and 1 m wide; the length will depend on ground conditions. Construction of the dike includes a water level controller.Escuchar

Live Barrier Dikes

Dikes will be built with live barriers with dimensions of 10-15 cm in diameter and up to 2.5 m long, using Espadillo, Black Wood, Piñuela and Tigüilote. Construction of the dike includes a water level controller.Escuchar

Construction of Water Management Works in the Silvopastoral System

According to the characteristics of each farm, we will define the type of water harvesting system, which can be small lagoons, hand-dug wells, collection fountains, etc., which will project the amount of compensation depending on the materials required and the beneficiary will assume labor or materials available on their farm.

Structure of the Model

Although the model presents variables for natural regeneration and plantation, with regard to the forestry component, it conserves the structure on the illustration.

The illustration shows the model on a sloping plot with different livestock rotation, forestry coverage, grasslands and the component for conservations works to guarantee better soil conditions in these municipalities while generating income for families and development of the area with sustainable projection.

Source: Consultation Workshop with Farmers, El Jicaral, El Sauce and Cinco Pinos, August 2005

Structure of the Model with the Natural Regeneration Variable

Grassland Component	Parameters	First Season	Last Season	
	Species	Angleton, Gamba, Brachiaria, Taiwan, King Grass.		
	Seeds Kg/ha	10-15		
	Arrangement	Planting by scattering seeds		
Agriculture	Crop		Maize	Sorghum
	Seeds Kg/ha		9	7
	Variety		Creole	Creole-Corn
	Arrangement		Scattered Seeds – Planting with Seeds	
Creeping Leguminous	Species		Velvet or Canavalia	
	Seeds Kg/ha		45	
	Arrangement		Scattered Seeds – Planting with Seeds	

Implementation of the Silvopastoral System

We propose the establishment of 3 soil and water conservation practices, 2 agronomic practices to improve soil fertility and practice to control soil drying effects. The introduction of these practices will improve animal performance, greater security to the drinking water of animals, reduce erosion, increase aquifer recharge and enhance biodiversity while increasing family income for farmers.

Establishment of the Components (grasslands, agricultural and forestry)

Pastures will be established in the first planting season in conjunction with the leguminous, taking into account that the harvest period of these components will be 180 days, according to weather conditions. The forestry component is set in the last season when it comes to planting and in the first season when it comes to natural regeneration. Living fences are set by stakes before the rains start during the first season. The agricultural component is also set for the last season, since these crops are used for cutting within 50 days after its establishment.

Activities Encompassed by the System

By way of example, the sequence of activities by component is presented as follows:

Activities that the model encompasses for its establishment

Component	Practice/Time	J	F	M	A	M	J	J	A	S	O	N	D
	Site Selection		X										
Grasslands	Natural Regeneration			X									
	Crop					X							
	Management						X	X	X	X	X	X	X
	MIP						X	X	X		X	X	X
	Fire Cutting Rounds	X	X					X	X			X	X
Agricultural													
	Crop								X	X			
	Management								X	X	X	X	
	Biomass Cutting											X	
	Incorporation into Pasture												X
Forestry													
Shrubs and Scattered Trees	Selection of Species			X	X	X							
	Natural Regeneration			X	X	X							
Live Fences	Plant and Stake Preparation (nurseries)	X	X	X	X						X	X	X
	Transportation of Plants					X							
	Holes and Distribution						X						
	Plantation						X						
Green Fertilizer													
	Canavalia and Velvet Crops					X							
	Management					X	X	X	X				
	Biomass Cutting								X				
	Incorporation of Pasture									X			
Conservation Works	Fountains with Filters		X	X	X	X							
	Infiltration Chambers			X	X								
	Barriers												
	Stone Dikes and Live Barriers			X	X								
	Maintenance of Conservation Works	X	X	X								X	X

Advantages and Disadvantages of the "Silvopastoral Model on a Shrubby Hillside"

Advantages	Disadvantages
Contributes to soil conservation, retention of water erosion and improves soil structure and fertility	The time factor is a limitation since these are mid and long term processes
Food production for livestock, organic fertilizer, firewood and other forestry products	The establishment and management of the model requires funding for the farmer
Improves dairy product production for self-consumption and trade, both in the local and export markets	They are high risks due to existing drought problems in these municipalities
Captures carbon in the biomass and soils	Requires more qualified personnel
Improves the landscape and increases land value	
Improves socioeconomic conditions in rural areas	
Incidence in the area's micro climate	
Contributes to healthy management of the stockbreeder population	
Reduces water stress risks among the stockbreeder population	
Helps to recover degraded soils	
Serves as an element for awareness among neighboring farmers	

Source: CATIE 1999, Agro-Forestry Teaching Module

Training

This is about a teaching process – participatory learning, for which different theoretical-hands on workshops will be implemented. The intention is to reinforce knowledge that stakeholders already have, in addition to calling their attention to the effects of degradation, the lack of protection and conservation of different resources available in the area and that influence the project, as well as having the beneficiaries appropriate themselves with the laws that regulate these resources.

A series of subject matters for training are proposed but these will be consulted with the beneficiary families when the farm plans are made. The proposed subjects are as follows:

1. Climate Change
2. Production Systems (forestry, agro-forestry, silvopastoral)
3. Soil and water conservation
4. Comprehensive crop management
5. Elaboration of organic fertilizers
6. Elaboration of botanical pesticides
7. Biological, physical and mechanical pest control
8. Forestry Management
9. Environmental Education
10. Operation and Organization of Fire Control Brigades
11. Water Resources Management
12. Participatory Planning on Farms
13. Pasture and Fodder Management
14. Alternative cattle feed for the dry season
15. Herd Management and Animal Health
16. Gender and the Environment
17. Payment for Environmental Services

Technical Assistance

Its basic role is to guide farmers so that they are not simple receivers of the knowledge they will develop with the project through training sessions or individual and group visits, but rather become replicators of technology adjusted to the specific traits of each farm, which is defined in the Adaptive Production Systems fostered by this project, with efficient management of natural resources and the environment.

This is based on the hands-on learning method, starting with the existing organizational structure of the project beneficiaries. The technical assistance will elaborate a monthly plan and then will be broken down into weeks in order to assess the scope and compliance with planned activities. To execute the technical assistance, there will be adequate technical staff for this purpose.

Methodologies:

- Group Assistance: it will be provided to farmer groups. Its content will be evaluation and information, using field validation and outreach implemented in productive activities.
- Individual technical assistance: it will be provided to individual farmers, accompanied by the respective promoter, and will consist of direct visits to plots in order to gather the respective information and monitor individual plans and activities.
- Field validations: will be performed in selected project areas. Their election and rating will be jointly performed with project promotion and coordination.

The technical assistance will be in charge of providing technical guidelines related to the following subjects:

1. Forestry Plantations
2. Fruit Plantations
3. Soil Conservation Works
4. Disaster Prevention and Mitigation Works
5. Use and Elaboration of Organic Fertilizer
6. Use and Elaboration of Botanical Pesticides
7. Live Barriers
8. Dead Barriers
9. Dikes
10. Ditches
11. Forest Fire Prevention Actions
12. Environmental Sanitation and other subjects identified in the farm plans

Promotion

Community leaders will be selected and trained; these will support the technological transference process to beneficiaries, transmitting knowledge, experience and skills; they will also guarantee summons for events and will serve as support for different project activities.

The Gender Approach

Gender equity analysis allows women themselves and men as well to recognize the opportunities and limitations that we have to attain personal and collective development within the historical and geographical context in which we live.

This is a matter of improving the specific development of each woman and man; improve the person, but also the community to attain a better individual and collective standard of living through actions that are

related to concrete ways of eliminating inequality. To this end, we must recognize the expressions that inequality assumes in the concrete historical and geographical contexts in which we live, work and act.

Each man and each woman have responsibilities to attain sustainable human development. Girls, boys, youth, adults, elderly women and men, each must contribute from their experience to promote and develop the community.

ENVIRONMENTAL ASPECTS

By developing this project, there will be a direct positive environmental impact through establishment of plantations and enrichment of forest galleries, there will be improved climate conditions, the level of soil erosion will diminish and future benefits will be produced such as local PES initiatives. In the same manner, use of silvopastoral and agro-forestry products and production of fruit trees will generate an alternative source of income for beneficiary families.

Future benefits are expected from different payment initiatives for environmental services (PES), which can be fostered, as they are a flexible, direct and promissory compensation mechanism, where providers of these services receive payment from the users themselves.

FARM PLANS

Intentions are to execute farm plans in a simple manner with farmers in order to learn the current status of the farm, i.e., how it currently is, area distribution and occupation, the trees it has, the materials available, the tools it has, among others. This will allow to identify the needs of the farm and the organization that can be provided to it, with the main purpose of using the soil space and to obtain maximum benefit from it.

Once the analysis of the current status of the farm is made and we have thought out how we want to have the farm within a time frame (dreamt and desired farm), proposals will be elaborated geared toward changes that will lead to achieving the farm's objective, obtain the maximum benefit with activities that generate income, achieving a better standard of living for the family while contributing to environmental conservation.

Elaboration of the activities plan will be made within a period of time. The purpose of this is to have guides for activities and to be able to define the best time for its implementation. In addition, it allows identifying the necessary materials and input for it execution and identification of what we have and what are needed. The latter allows us to develop our self-management capacity. The final result is the farm plan.

Annex 6

Environmental Permits for the Salale and Las Mercedes Irrigation Systems

ALCALDIA MUNICIPAL "EL SAUCE"
Departamento de León, República de Nicaragua C.A.
Telefax. 319-2259. mail:alsauce2004@yahoo.es

AVAL AMBIENTAL MUNICIPAL.

A través de la presente se le extiende el Aval ambiental Municipal a la Fundación Cuenta Reto del Milenio para la ejecución del Proyecto de Riego Las Mercedes, propuesto ejecutarse en la Comarca Las Mercedes en el Municipio del Sauce, así como la aprobación del Plan de Gestión Ambiental propuesto para este proyecto donde propone medidas de mitigacion ambiental ante los impactos negativos que genera el proyecto de riego, determinándose que es ambientalmente factible y que se apega a las exigencias normativas ambientales del país.

Se le extiende el presente documento para los fines que él estime conveniente.

Dado en la ciudad de El Sauce, a los tres días del mes de Septiembre del dos mil ocho.

Sr. Evertz Delgadillo Melgara
Alcalde Municipal
Alcaldia – El Sauce.

Ing. Aleyda Johana Luna O.
Resp. Unidad Ambiental Municipal.
Alcaldia – El Sauce.

ALCALDIA MUNICIPAL "EL SAUCE"
Departamento de León, República de Nicaragua C.A.
Telefax. 319-2259, mail alsauce2004@yahoo.es

AVAL AMBIENTAL MUNICIPAL.

A través de la presente se le extiende el Aval ambiental Municipal a la Fundación Cuenta Reto del Milenio para la ejecución del Proyecto de Riego Salales, propuesto ejecutarse en la Comarca Salales en el Municipio del Sauce, así como la aprobación del Plan de Gestión Ambiental propuesto para este proyecto donde propone medidas de mitigacion ambiental ante los impactos negativos que genera el proyecto de riego, determinándose que es ambientalmente factible y que se apega a las exigencias normativas ambientales del pais.

Se le extiende el presente documento para los fines que el estime conveniente.

Dado en la ciudad de El Sauce, a los tres días del mes de Septiembre del dos mil ocho.

Sr. Evertz Delgadillo Moreno
Alcalde Municipal
Alcaldía – El Sauce.

Ing. Aleyda Johana Luna O.
Resp. Unidad Ambiental Municipal.
Alcaldía – El Sauce.

ANNEX 7

Persons interviewed

1. Ministry of the Environment and Natural Resources:
   i. Suyen Perez.- Director of Climate Change
   ii. Raquel Sanchez.- General Directorate of Planning
   iii. Engracia Merlo.- General Directorate of Planning
   iv. Janire Álvarez.- Departamental Delegate León
   v. Orlando Caceres.- MST-MARENA
   vi. Glenda Oviedo.- Regional Node, SINIA, North Pacific

2. National Water Authority:
   i. Luis Angel Montenegro.- National Authority

3. Ministry of Agriculture and Forestry:
   i. Roger Rodríguez.- Director General of Policy
   ii. Benjamín Herrera.- Specialist in Land Use Planning
   iii. Arcángel Abaunza.- Director of Technology Policy

4. Social Investment Fund:
   i. Rodolfo Blandón.- Director of Operations and Development
   ii. Julio Canales.- Director of Purchasing
   iii. Yalmar Zamora.- Specialist in Water Supply and Sanitation

5. Ministry of Transport and Infrastructure:
   i. Fabio Guerrero.- Coordinator Environmental Management
   ii. Juergens Lacayo.- Construction Registry and Control

6. National Institute of Agricultural Technology:
   i. Miguel Obando.- Sub Director
   ii. Víctor Arana.- Sustainable Agriculture Program
   iii. Arlen Payan.- Specialist in Irrigation and Water Management
   iv. Homero Gallo.- Director, Occidental Research Center
   v. Ana Lucia Lorío.- Specialist in Sustainable Agriculture, Occidental Research Center
   vi. Juan José López.- Extension Worker, El Sauce

7. National Forestry Institute:
   i. Ingrid Torres Luna.- Coordinator, JICA-INAFOR Master Plan

8. Nicaraguan Institute of Territorial Studies:
   i. Javier Mejía.- Executive Sub Director
   ii. Isaías Montoya.- Director of Water Resources

9. Institute of Rural Development:
   i. Eddy Aburto.- Delegate Managua

10. Municipality of El Sauce:
    i. Rosa Amelia Valle Vargas.- Mayor
    ii. Orlando García Ibarra.- Deputy Mayor

iii. Carlos Castillo.- Director of Planning
iv. Johana Luna.- Environmental Management Unit
v. Luisa Carolina Velázquez L.- Director of Purchasing
vi. Pedro Anastasio Medina.- Cadastre
vii. Leonardo Ruiz.- Local Development Office
viii. Ciro Edén Pastora.- Las Mercedes Irrigators Association
ix. Jesús Rocha.- Las Mercedes Irrigators Association
x. Victorino Pérez.- Las Mercedes Irrigators Association
xi. Salvador Parrilla.-Coordinator, Salale Irrigators Association
xii. Luis Espinoza Mendoza.- Municipal President UNAG.
xiii. Milker Hernández.- World Vision
xiv. Isabel Gadea.- Coordinator Community Cabinet, Petaquilla

11. Municipality of Achuapa
    i. Diego David Figueroa Gontol.- Mayor
    ii. Adonías Corrales Blandón.- Deputy Mayor
    iii. Nubia López.- Director of Infrastructure and Water Projects
    iv. Francisco López Gontol.- Environmental Management Unit
    v. Ronald Urbina.- Credit Unit, Multisectoral Cooperative Juan Francisco Paz Silva

12. Municipality of Villanueva
    i. Juan Fernando Gomes Ovando.- Mayor
    ii. Alfredo Aragón.- Environmental Management Unit
    iii. Juan Manuel Gaitán.- Risk Management

13. Municipality of Somotillo
    i. Kenny Alberto Espinoza Gaitán.- Mayor
    ii. Daniel Paredes.- Environmental Management Unit
    iii. Eduardo Real.- Agriculture Coordinator
    iv. Luis Rodríguez Espinoza.- Community leader, Citizens' Power Cabinet
    v. José Francisco García.- Producer - Apacunca
    vi. Juan Betancourt.- Community leader, Jicote
    vii. Felipe Méndez.- Farmer- Emergency Committee
    viii. Santos Méndez.- Farmer - Apacunca
    ix. Hamilton Flores Ríos, - Rancher- Matapalo
    x. José Reyes Suazo.- Farmer - Apacunca

14. Municipal Associations
    i. Horacio Lanzas Reyes.- Executive Director, Association of Municipalities of Northern Chinandega-AMUNORCHI
    ii. Sara Guillermina Franco.- Executive Director, Association of Municipalities of León-AMULEON
    iii. Roberto García- Head of Environmental Management Unit, Association of Municipalities of Nicaragua.

15. Other Organizations
    i. Irving Larios Sánchez.- Institute of Social Research-INGES
    ii. Diego Gómez.- Institutional Strengthening Specialist, Integral Watershed Management, Water and Sanitation Project-PIMCHAS
    iii. Guillermo Rodríguez.- Head of Cooperation with Nicaragua, Friedns of teh Earth, Spain.

16. Universities
    i. Maritza Andino.- Anthropology Department – Autonomous National University of Nicaragua-Managua
    ii. José Inés Varela.- National Institute of Technical Training - El Sauce

ANNEX 8

Detailed Indicative Budget

Component 1	**$2,477,215**
Construction contract Irrigation Systems, Las Mercedes and Salale	$727,215
Construction contracts, rainwater collection and storage facilities	$1,650,000
Consulting Contract, Civil Engineer, Project Team	$65,000
Supplementary Training Contracts	$35,000
Component 2	**$1,302,785**
Stipends for Agro-ecology students	$77,185
Workshops and site visits with Agro-ecological producers	$55,800
Materials for implementation of agro-ecological farm transformation plans	$1,069,800
Materials for demarcation and protection of water system recharge areas	$100,000
Component 3	**$400,000**
Stipends for Anthropology students	$19,200
Consulting contract, gender and family role workshops	$60,000
Workshops and technical assistance, micro-watershed management plans	$120,000
Operational expenses, municipal technical teams and micro-watershed committees	$150,800
Workshops and technical assistance, sub-watershed management plan and committee proposal	$40,000
Workshops, incorporating climate change issues in muncipal plans	$10,000
Component 4	**$440,000**
Hydrological study, causes of flooding in Villanueva River sub-watershed	$120,000
Training and participatory monitoring of soil and water conditions in targeted micro-watersheds	$62,960
Equipment, installation and operation, electronic information posts	$94,500
Consulting contracts, SINIA project coordinator and 8 computer technicians with GIS skills	$145,040
Annual lessons learned reports	$17,500
Project Execution	**$450,000**
Project office	$53,000
Consulting contract, Project coordinator	$96,000
Consulting contracts, extension workers	$138,000
Consulting contract, adminstrator	$16,800
Vehicles	$34,000
Operating Expenses	$112,200
Total Project Cost	**$5,070,000**
Project Cycle Management	**$430,000**
Inception workshop	$500
Annual reports	$500
Mid-term evaluation	$20,000
Final Evaluation	$20,000
Audits	$45,000
Monitoring Field Trips	$2,000
Other	342000
Amount of financing requested	**$5,500,000**

ANNEX 9

DRAFT TERMS OF REFERENCE -- PROJECT COORDINATOR

REDUCTION OF RISKS AND VULNERABILITY FROM FLOODS AND DROUGHTS IN THE ESTERO REAL RIVER WATERSHED

I. INTRODUCTION

Within the framework of the Kyoto Protocol, with the Climate Change Adaptation Fund, MARENA with UNDP support will execute a project called "Reduction of risks and vulnerability from floods and droughts in the Estero Real River watershed". This watershed has been seriously affected by great floods and extended droughts, which has caused reduced productivity and affected food security.

The project will concentrate its resources in micro-watershed in the upper parts of the Villanueva River Sub-Watershed in the municipalities of El Sauce, Achuapa and Villanueva; it will also support mechanisms so that the nine municipalities on the Estero Real River Watershed incorporate measures to adapt to climate change in its territorial organization plans, water use and investment, as well as related regulatory instruments.

Background

In Chinandega and Leon, the Estero Real River Watershed, and particularly the Villanueva River Sub-Watershed, deforestation and inadequate land management practices, particularly in the upper and middle watershed, have caused high erosion and sedimentation rates that have weakened agricultural production and threaten food security. During the rainy season, landslides in the middle watershed and heavy flooding in the middle and lower watershed are common, aggravated by extreme events such as hurricanes or storms, causing heavy losses in harvests, human lives, domestic animals, damage to infrastructure and a progressive deterioration of local economies. During the dry season, many surface sources dry up and insufficient rainfall limits access to water and reduces productivity, even when there is not an outright drought..

The Government of Nicaragua, with support from the Climate Change Adaptation Fund will intervene in Watershed 60 to carry out a series of actions that respond to long term reduction of risks from drought and flooding caused by climate change and variability. The project will create mechanisms for local implementation of the National Environmental and Climate Change Strategy, as well as the micro and sub-watershed management structures called for in the General Law of National Waters, incorporating climate impact considerations. Municipal governments, community organizations, farmers' associations and technical experts from national institutions, citizen power cabinets and local population should converge in these structures.

El objective of the project is to reduce risks from droughts and flooding generated by climate change and variability in the watershed of the Estero Real River. To reach the objective, the Project will rely upon a coordinated set of interventions designed to implement new public policies for addressing climate change by introducing agro-ecological practices and participatory watershed management in highly vulnerable rural communities. Through targeted investments in water retention, long-term farm planning, and institutional capacity building in local communities, municipalities and government agencies, the Project will validate an adaptation scheme as a vehicle for implementation of the national climate change strategy. The project will have four outcomes:

1. Reduced risk of climate induced water shortages for small scale domestic and productive uses in eight micro-watersheds in the upper watershed of the Estero real River.
2. Strengthened climate resilient agro-ecological practices for the effective use of available water in the eight targeted micro-watersheds.

3. Enhanced institutional capacities for the incorporation of climate change risk management in work plans, policies, and normative instruments in the Villanueva River sub-watershed, and the watershed of the Estero Real River.
4. Disseminated results and lessons learned about building climate change resilience in vulnerable rural communities. This will be based on ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality.

II. OBJECTIVE OF THE CONSULTING SERVICES

Guide the implementation of the Project "Reduction of risks and vulnerability from floods and droughts in the Estero Real River watershed" achieving the proposed outcomes, under the guidance of the Project Coordination Committee (PCC).

III. CONSULTING SERVICES' SCOPE AND DURATION

The consulting services will be undertaken in the project's area of influence, for a four year period, subject to the administrative reviews of the MARENA Climate Change Directorate.

IV. FUNCTIONS

Work will be performed under the administrative direction of the MARENA Climate Change Directorate in order to obtain the outcomes required to comply with the project objective. Concretely, the Project Coordinator should:

- Prepare annual work plans and budgets.
- Coordinate with local government and non-governmental institutions linked to project development.
- Coordinate and manage project implementation, including monitoring and communications, as well as supervision of expert teams and the integration of micro and sub-watershed management structures.
- Direct the project technical team.
- Coordinate implementation of the specific activities and tasks described in the project's annual operational plans (AOP) with the technical team and other relevant stakeholders.
- Create coordination mechanisms in the different levels of work and generate synergies among different participants as well as among diverse activities, products and results.
- Facilitate compliance with the activities and schedules established in the AOP.
- Facilitate conflict resolution among stakeholders and resolve obstacles in the way of timely efficient implementation of activities and achievement of outcomes.
- Prepare a specific project communications and public information plan under the guidance of the PCC.
- Submit regular reports.
- Others, as set forth in the Project Document

VI. CONSULTANT'S PROFILE

University graduate in anthropology, sociology, social psychology, adult education or agronomy with experience in the introduction of a gender focus in adaptive watershed management.

Demonstrated experience in promoting processes of social and organizational change in Nicaraguan public administration at the national, and particularly, at the municipal level.

The following will be positively valued:

- Knowledge and/or experience in projects with a watershed approach

- Experience in adaptive agro-ecological practices
- Knowledge of municipal management and territorial organization
- Experience in preparing educational programs
- Awareness of climate change issues

For performance of functions, the person must meet the following requirements:

- Ease of expression in Spanish
- Social skills and ease in dealing with people
- High achievement motivation
- Willingness and flexibility to work with few resources and under pressure
- Awareness of development cooperation issues
- An integrating and proactive personality
- Capacity for teamwork as a team, including coordination, consensus building and establishment of inter-personal and inter-institutional relations, including international cooperation institutions, ministries, local governments, other organizations and stakeholders in the area of interest of the project
- Integrity, responsibility, initiative, a respectful approach to human rights
- Exclusive dedication

VI. FEES

The manner of payment will be monthly, for an amount of …… equivalent to……

ANNEX 10

Gender and Family Role Workshops

1. Background

There have been a number of rural development projects in Nicaragua which have made significant efforts to enhance gender equality. One of these—the Sesame Production and Marketing Project in Nicaragua (PRODUMER II), carried out by the Mennonite Economic Development Associates (MEDA) for the Canadian International Development Agency (CIDA)—was active from 2005 to 2009 in various communities located within the Villanueva River Sub-watershed. Near the end of the PRODUMER project, CIDA suggested that MEDA undertake a gender strategy implementation review[1] in order to identify lessons learned and provide recommendations for future projects in the area.

The central activity of the PROUMDER Gender Strategy was a series of six workshops held over a period of two years. All the sesame producers involved in the project were invited to the workshops. In the strategy review, in depth interviews were held with 34 producers and their spouses, selected at random from among two groups: those who had attended at least three gender workshops and those who had attended less than three.

The key finding of the review was that *wide variations were apparent in the degree of appropriation of a gender focus and a commitment to behavioural changes that tend toward greater gender-equality*. The review described these differences as follows:

> *At one extreme a few participants affirmed and demonstrated an enthusiasm for promoting gender equality that is affecting many areas of their lives. They described a series of behavioural changes in relation to:*
>
> - *<u>the household</u>: men washing clothes, fetching water, sweeping floors, changing diapers, cooking, and helping care for chickens and pigs.*
> - *<u>children</u>: greater dialogue, cessation of corporal punishment, encouragement of boys to assume household tasks, encouragement of girls to study and/or to assume roles in productive activities.*
> - *<u>inter-personal communication</u>: conscious efforts to be patient, to listen, to respect the other's point of view, to discuss important issues, to converse and share emotions, especially between spouses but also with other family members.*
> - *<u>agricultural production</u>: women participating and/or taking the lead in crop planning, managing traceability registers, calculating costs and benefits, negotiating sales.*
> - *<u>social leadership</u>: women attending meetings, promoting participation of others, speaking up in public, assuming formal leadership positions in cooperatives and community organisations; men encouraging other men to change traditional macho behaviours and supporting those who make the change.*
> - *<u>self-motivated role definition</u>: women and men defining their respective roles through identification of individual traits and interests, regardless of traditional gender patterns.*

[1] MEDA. Gender Strategy Implementation Review. PRODUMER II. December 2008.

Eight of the 34 producers/spouses interviewed, six women and two men, appear to belong in this category. They seem to have an internal motor running which pushes them to identify areas where existing cultural patterns interfere with gender equality and to seek ways to change the restrictive behaviour. In at least two cases this attitude forms part of a creative drive that has led to experimentation and innovation in agricultural production as well.

At the other extreme, six of the producers/spouses interviewed—three women and three men—did not show or convincingly identify any change in attitude or behaviour that would tend toward greater gender equality….

The remaining 18 producers and spouses who participated in conversations with the reviewer appear to be at different points in a continuum between the eight active promoters of gender equality and the six who appear to remain untouched by the project's efforts to induce this cultural change. … While the members of this group do not appear to have an internal motor driving them toward ever more gender equality, they do appear to have internalized a (perhaps somewhat nagging) sense that they, and others in their communities, <u>should</u> change. Their pride in their own changes indicates a sense of advancement, and they criticize, for example, those men who still refuse to eat until their spouses serve them. Only at the upper end of the continuum, however, do they articulate interest in actively seeking to stimulate a shift toward gender equality in their communities.

The review sought to identify and analyze the factors that caused these differences. This outline lists the recommendations derived from that analysis and indicates how they will be applied in the proposed project.

2. Repetition

The project will offer a series of workshops in each micro-watershed. A single workshop is not enough to effect behavior change. Participation in at least 4 workshops will be the goal for the couples engaged in preparing and implementing agro-ecological farm transformation plans.

3. Economic analysis of gender-specific roles

This is a key element. Participatory task and role analysis is a common practice in rural development efforts and is often used as a backdoor entry into gender analysis, effectively disarming automatic male defences against the word "gender". The PRODUMER workshops took this one step further by including a detailed process in which:

- *gender-specific groups of men and women estimate the monetary value of the tasks on the lists generated in the participatory task and role analysis, and*
- *each group presents its estimates to the other and explains, defends or adjusts them in the ensuing plenary debate.*

The PRODUMER review found that this process made a deep impression on many participants.

4. P eer support

Behavioral change is made much more difficult when it is being criticized or ridicules by friends and neighbors. It is easier if. The workshops will be held in the micro-watersheds for groups of couples, so that ensuing efforts to change behavior can be accompanied by peer support.

5. Workshop leader personality

The facilitation skills and personality of the workshop leader are very important. A specialist in preparing and conducting gender workshops will be contracted to plan and carry out carry out two sets of 8 workshops in each micro-watershed (a total of 32 workshops each year for four years).

6. Outreach worker attitude

In discussion of this point the PRODUMER review states:

> *Two somewhat different perceptions of the reason for having a gender focus in the project were expressed by the four extension agents interviewed. One perception could be described as generic support for gender equality. This view is that gender equality is an important societal goal, that a major cultural shift toward greater gender equality is underway in our society, and that every social change project can and should include efforts to support and accelerate this shift.*
>
> *The second perception could be described as recognition of a desperate need for all available talent and energy. In this view the challenge faced by any effort to help smallholder subsistence farmers emerge from chronic poverty by entering the market economy is so overwhelming that attempting it without freeing both men and women from the crippling structures of traditionally gender-determined roles is like trying to run an obstacle course with both legs in plaster casts.*
>
> *The first view assigns gender-awareness activities an important secondary place in the project, right behind the primary agricultural production and marketing component. The second view locates gender-awareness activities as a tool which is essential if there is to be any possibility of success in agricultural production and marketing.*
>
> *The sharpest illustration of the validity of the second view in the project relates to the need for sesame producers to keep traceability records of their production and sales process. Many producers interviewed do not keep such records. Among those couples who do keep them, it is the woman who actually does the recording. This was found to be a natural product of the fact that the women involved could read and write while their spouses could not. In those cases, if women's hands are kept off agricultural production activities, analysis and planning, there will be no traceability records.*
>
> *Not surprisingly, the two agricultural extension agents who clearly hold the second view have been much more successful in achieving massive and repeated attendance by their producers in focus group workshops.*

In recognition of the importance of outreach worker attitudes, the project will endeavor to ensure that all members of the project team:

- h
  ave spent the most time reflecting about gender relations in their own lives and consciously crossing traditional gender barriers in their own behaviour.
- show a willingness to enter into personal relations with farm families in a role other than that of a provider of agricultural expertise.

In addition specific gender role analysis workshops will be designed and held for project staff. All the members of the Municipal Technical Teams (MTT) will be invited to participate in these workshops.

7. Youth participation

Changing traditional gender roles has important impacts on intra-family relations, and can lead to opportunities and difficulties in relation to children. The gender specialist will be asked to ensure that 3 or more of the series of 8 workshops are designed to enable older children in the farm families to participate together with their parents.

ANNEX 11-UNDP Environmental Finance – Specialized Technical Services

Stage	Specialized Technical Services Provided
Identification, Sourcing and Screening of Ideas	Provide information on substantive issues and specialized funding opportunities (SOFs)
	Verify soundness and potential eligibility of identified idea
Feasibility Assessment / Due Diligence Review	Technical support: provide up-front guidance; sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Provide detailed screening against technical, financial, social and risk criteria and provide statement of likely eligibility against identified SOF
	Assist in identifying technical partners; Validate partner technical abilities.
	Obtain clearances – SOF
Development & Preparation	Technical support, backstopping and troubleshooting
	Technical support: sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Verify technical soundness, quality of preparation, and match with SOF expectations
	Negotiate and obtain clearances by SOF
	Respond to information requests, arrange revisions etc.
	Verify technical soundness, quality of preparation, and match with SOF expectations
Implementation	Technical and SOF Oversight and support
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in Inception Workshop
	Technical information and support as needed
	Technical support, participation as necessary
	Advisory services as required
	Allocation of ASLs
	Technical support and troubleshooting, Support missions as necessary.
	Project visits – at least one technical support visit per year.
	Technical support, validation, quality assurance
	Return of unspent funds
Evaluation and Reporting	Technical support, progress monitoring, validation, quality assurance
	Technical support, participation as necessary
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in briefing / debriefing
	Technical analysis, compilation of lessons, validation of results
	Dissemination of technical findings

Service standards:

1. initial response to communication within 2 working days
2. full response to communication (with the exception of a response requiring travel) within 10 working days

ANNEX 12

List of Acronyms

ANA	National Water Authority
CAPS	Drinking Water and Sanitation Committee
CAI	Inter-institutional Support Committee
COFODEC	Cooperative Fund for Farm Development in El Sauce
PCC	Project Coordination Committee
PC	Project Coordinator
CURS	Regional University Center, Somotillo
DNP	Directorate of Climate Change, MARENA
MTT	Municipal Technical Team
FISE	Social Investment Fund
GEF	Global Environment Fund
INAFOR	National Forestry Institute
INETER	Nicaraguan Institute of Territorial Studies
INIFOM	Nicaraguan Institute of Municipal Development
INTA	Nicaraguan Institute of Agricultural Technology
IDR	Institute of Rural Development
INATEC	National Technological Institute
INTUR	Nicaraguan Institute of Tourism
MAGFOR	Ministry of Agriculture and Forestry
MARENA	Ministry of the Environment and Natural Resources
MST	Sustainable Land Management Project
MTI	Ministry of Transport and Infrastructure
NOAA	National Oceanic and Atmospheric Administration (United States)
ONG	Non-Governmental Organization
PNDH	National Human Development Plan
PIMCHAS	Integral Watershed Management, Water and Sanitation Project
UNAG	National Union of Farmers and Ranchers
UNAN	National Autonomous University of Nicaragua

UGAM	Municipal Environmental Management Unit