

Scope of Work Statement
Reforestation Plan for the Lower Lempa

El Salvador

August 2001

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Executive Summary

This report provides a conceptual framework for developing a detailed, multi-stage plan for sustainable forest development.

Typically, a detailed reforestation plan describes specific procedures for planting trees and other forest management activities, such as thinning, pruning, clearing, and selective harvesting.

A comprehensive reforestation plan will include ways to meet community forestry needs while improving soil conservation and reducing erosion. Widespread excessive cutting of trees causes more stormwater runoff to enter rivers, such as the Lempa River. Also, development of more villages and expanding agriculture land use, including sugar and bean farming, results in the clearing of what was once natural forest. When forest land is cleared of trees, loosened soil erodes into rivers. The soil builds up and reduces the natural water storage capacity of the river. This combination of more runoff and reduced river capacity causes more frequent flooding in the Lower Lempa communities. In addition, the eroding soil may contain contaminants that pollute the water and impact the spawning grounds of aquatic species by smothering the eggs.

1. Plan Objectives

The purpose of a reforestation plan is to combine responsible land use with forest planning that will supply the communities with timber and other forest products while reducing erosion of valuable topsoil. Specifically, the following objectives will be considered when selecting specific species of trees, shrubs and grasses to be used:

- Plant and maintain trees to provide enough timber to meet the communities' basic needs for fuel, construction and other forest products.
- Combine good forest management while allowing communities to use their land for homes and agriculture.
- Reduce the damage to land caused by erosion, floods, landslides and other effects of ecological imbalance.
- Conserve the ecosystem.
- Establish new community forests in open and degraded areas.
- Promote citizen participation in developing the forestry plan. The new plantings will require development, management and conservation that will need to use resources, such as including time and labor, that are available to the community.

2. Project Area

The project area is located in the delta region of Lempa River, as shown on Figure 1. Global Village Engineers identified 15 open and degraded areas along the new levee in Usulután and San Vicente. These areas are labels A - O on Figure 1. For reference, this region is divided into the following three sectors:

Sector 1 - Located on the San Vicente side of the river, between the Litoral Highway in San Nicolas Lempa and extending down to La Pita, at the Pacific coast.

Sector 2 - Located on the Usulután side of the river, between the Litoral Highway in San Marcos Lempa and the Nancuchiname Forest.

Sector 3 - Located on the Usulután side of the river, between the Nancuchiname Forest and La Canoa.

3. Protective Planting and Reforestation Along the Levee

Plantings on the river side of the levee will create a natural protective screen that will protect the new levee from the river during high flows. Trees and shrubs will be planted at least eight meters from the toe of slope of the levee, as shown in Figure 3.

Tress and shrubs for community uses, such as fruit trees, grazing plants and hardwood trees should be planted on the dry side of the levee, as shown on Figure 2. This way, communities can access these resources without crossing and disturbing the levee.

The lower reaches of the river are influenced by the tides of the Pacific Ocean. These swampy, salt water areas, can be reforested with a combination of white and button mangroves, which are valuable for the ecosystem and as wood for fuel and construction uses. Smaller shrubs, such as the sea hibiscus, can be planted along with the mangroves, too, in most areas. Global Village Engineers recommends that areas where mangrove plantings are needed be identified. Figure 4 is a suggested planting scheme for mangroves, which should be developed in more detail.

Only species native to El Salvador will be considered for planting. In the levee design report by Consulta, S.V., for the levee extension project, specific species of native plants were suggested for these protective plantings along the levee. The following plant species will be considered for use in this plan:

Table 1: List of Proposed Species for Planting along Levee

Species Type	Species Use
Soursap Tree (<i>Annona glabra</i>)	Small tree to 50 feet, spreading round crown. Prefers partial shade or partial sun to full sun; soil should be moist to wet
Caobillo (<i>Caropa guianensis</i>)	Commonly 80 to 100 ft in height with diameters 2 to 3 ft; sometimes attain diameters up to 6 ft and heights of 170 ft. Suitable for all types of construction where durability is not a factor; furniture and cabinet work, flooring, joinery, millwork, veneer and plywood, and turnery.
Caulote (<i>Guazuma ulmifolia</i>)	This is a shrub or small tree generally consumed as forage by domestic animals. Caulote provides nice shade and also works as a live fence.
Majague (<i>Thespesia populena</i>)	This is a hibiscus-type evergreen shrub or small tree that is suitable for dry locations and saline conditions. It is commonly used to reduce erosion control and on the outer perimeter of mangroves and brackish areas.
Tihuilote (<i>Cordia dentata</i>)	Widely adapted, grows in alluvial and clay soils, and in humid and dry climates. It grows best in full sunlight, and easily colonizes recently disturbed areas and is also found growing along stream banks. It is a common species in secondary forest growth.
The following plants are suitable in the mangroves or estuaries of the Lower Lempa.	
Button Mangrove (<i>Conocarpus erectus</i>)	Mangrove wood is ideal for firewood and charcoal production. Timber from many species of mangrove is strong, durable in

**Generic Reforestation Plan
For the Lower Lempa Region**

<p>White Mangrove (<i>Lanuncularia racemosa</i>)</p>	<p>water and attractive. The heartwood is prized for furniture. Mangroves are valuable for other reasons as well. Mangrove swamps protect coastal and estuarine areas from damaging storm winds and water erosion. They provide spawning and nursery grounds for fish, shrimp, crabs, clams, oysters and crocodiles. They are feeding and nesting areas for birds and other wildlife. Additionally, tannins and resins can be extracted from various species.</p>
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4. Planting Guidelines

In a detailed reforestation plan, this section will include methods for transporting and handling the seedlings, how to prepare the soil, how far apart to plant the seedlings, watering requirements, removing invasive weeds, and propagating new plants from existing ones.

These details are specific to the exact species of plants selected for the project. The following are general guidelines to help the communities plan for future citizen participation in this plan.

Guidelines for handling seedlings:

- Tree seedlings will be kept moist and be stored in a shaded, dry area until planted.
- Seedlings will not be exposed to excessive drying when being handled for planting. The seedlings will be carried in a planting bag and remain closed until they are placed in the planting hole.
- Seedlings will be planted in damp soil during the early wet season.
- Planting holes will be opened deep and wide enough so that the seedling roots can spread evenly throughout the hole.

Guidelines for Site Preparation

- Invasive plants are any plant which will compete against plantings for light, nutrients, and space. Invasive plants within the planting area will be completely removed before new plantings are established.
- Grading, compacting or moving soils within planting areas should be reduced to the minimum extent practicable. If grading is necessary, compaction of the soil will be avoided. Compaction reduces infiltration of water into the soil, which prevents water from reaching the plants root system.
- Heavy human and machine traffic within the planting area will be avoided as much as possible. Areas away from the plantings should be designated for vehicle traffic and parking.
- Fences should be installed around the entire planting area to ensure cattle do not eat or destroy the seedlings.

- Existing trees and shrubs on the river side of the levee help protect the levee from the river and will not be removed during the reforestation process.
- Dead trees located in or adjacent to any planting areas will be completely removed, including the roots.
- Soil conditions, including type of soil (sand, clay, silt, etc.) and pH will be identified before planting.

Planting spacing requirements:

- Tree seedlings will be planted at regular intervals to promote maximum growth.
- Seedlings will be spaced at the distance equal to its maximum spread at maturity. The spread of the tree is the full diameter of the tree measuring from branch to branch. For example, tree seedlings that mature to spreads of 20 meters should be planted 20 meters apart.
- If possible, large plots of land should be planted with a stand of trees. Large planting areas are more beneficial than smaller areas because it is more efficient to centralize labor and energy at one large site as opposed to several small sites.

Locations of Plants

- The river side of the levee requires trees with strong rooting and branching patterns. Since these trees are crucial to protection of the levee, they should never be cut down for firewood or construction purposes. The hibiscus and tihuilote are both excellent plants for this purpose. See Figure 3 for a suggested planting layout.
- The dry side of the levee provides an opportunity to support the agricultural and commercial demands of the surrounding communities. Fruit trees, such as the soursap tree, and hardwood trees, such as the caobillo and shrubs such as the caulote are all suggested for the dry side. See Figure 2 for suggested planting layouts.
- In the salt-water marsh areas, the white mangrove and button mangrove trees are recommended. These are suitable only in estuaries and salt water marshes. It is important to replant mangrove trees, which provide timber that is valuable for fuel, furniture and other uses. Also, there are variations of shrubs, such as the sea-hibiscus, which can be planted among the larger trees. Smaller shrubs will thrive in a stand of mangroves and

will help reduce coastal erosion. See Figure 4 for a suggested layout of mangroves and sea-hibiscus.

Post-planting recommendations

- Continue to remove any invasive plants from the areas which may impede the growth of the new shrubs and trees.
- Continue to leave soil loose and uncompacted in the planting areas to ensure successful rooting and long-term growth of shrubs and trees.
- Continue to keep cattle clear of the planting areas. This may require additional fence construction and maintenance over time.

5. Forest Regeneration Plan

To establish forest growth, planting should be done in specific stages. The first stage includes clearing planting areas, then planting some seedlings and complementary grasses. Grasses will provide ground cover for erosion control while allowing the trees enough light, moisture, and space to take root and grow. Overall, ground cover should be sparse during the first year and become increasingly lush by the second and third years.

A reforestation plan will need to have a diverse mixture of plants. Generally, two types of trees are needed crop trees and nurse trees. Crop trees are long-lived species that mature into valuable forest products. In the species list provided by Consulta, S.V. and shown in Table 1, the caobillo, button mangrove and white mangrove would be considered crop trees.

Nurse trees and shrubs assist the crop trees by enhancing the organic matter and nitrogen content in the soil. Nurse trees and shrubs can be cut once the crop trees need additional growing space. In Table 1, the caulote, majague and tihuilote are more likely considered nurse trees.

Any dead trees should be removed to prevent wildfires.

6. Soil and Water Conservation Goals

This section of the reforestation plan will include an analysis of the existing soil conditions in the areas identified for planting. Soil will be identified by its characteristics, such as sand, silt, clay or gravel and by its chemistry. For example, pH and nitrogen content should be measured in samples taken from each planting area.

Global Village Engineers recommends that these characteristics be documented when selecting species for each planting area.

7. Protective Measures

Ideally, the detailed reforestation plan will include native species that are extremely resistant to disease and insects.

Species that are valuable but readily susceptible to disease require much time and many resources to keep healthy. Thus, they are inappropriate for a community-based reforestation effort.

The detailed plan should also address the potential for wildfires, and include buffer zones between forest areas and residential zone. The purpose of a buffer zone is to prevent forest fires from reaching the communities. Generally, there should be a buffer zone approximately 35 meters wide between forested areas and the nearest home or agricultural field. This buffer zone should be clear of trees and shrubs, as well as debris that could support a fire.

8. Silviculture Practices Required, Sequence, and Specification

Silviculture is the practice of cultivating forest crops. This section of a detailed reforestation plan will discuss the long-term forest management considerations that will ensure the sustainability of the new plantings. This section will deal with proper methods and schedules for extracting wood without depleting the new forest.

9. Cost Estimate

One of the most important parts of a reforestation plan is establishing the necessary budget. The overall estimate of the project will require careful consideration of the following costs:

Plants:

Quantity and cost of each type of plant needed. The estimate will list each species to be planted, and the total number of plants needed.

Soils:

Quantity and cost of new soils. In some cases, the existing soils may be eroded too severely to support new plantings. It may be necessary to purchase and transport topsoil to the site before planting can begin.

Labor:

Shrub and tree planting costs - Labor and equipment will be needed to plant the seedlings.

Re-Planting:

Over time, some of the seedlings may die, and need to be replaced. An amount (possibly 5% to 10% of the total cost for the plants) should be set aside to pay for the cost of replacing plants that die.

Maintenance:

Maintenance includes planting new seedlings and propagating plants from established growth. The details of the silviculture plan will affect the longer-term maintenance costs.

Appendix A
Definition of Terms

For your reference, the following terms are commonly used in detailed landscaping plans and reforestation analyses.

Afforestation	Establishing of a tree crop on an area where trees have been naturally absent.
Basal Area	The area of the cross-section of a tree stem at breast height.
Reforestation	The natural or artificial restocking with trees on forestland.
Regeneration	The renewal of a tree crop by natural or artificial means.
Silviculture	The science and art of cultivating forest crops for the production of forest services; the theory and practice of controlling forest establishment.
Stand	A community of trees possessing sufficient uniformity in regard to age, spatial arrangement, or condition.

Appendix B

Figures