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AN ENVIRONMENTAL ASSESSMENT OF THE PROPOSED ACDI PINEAPPLE NURSERY ACTIVITY

By

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PROLOGUE

This environmental assessment report was originally presented to the USAID Sri Lanka Mission in April 1992 by Agricultural Cooperative Development International (ACDI) after a draft version was reviewed by the Mission environmental officer and others. It was subsequently forwarded to AID/Washington by the USAID/SL Mission for review and approval, which was delayed as, in their view, the action plan presented in the assessment did not contain sufficient detail. Furthermore, AID/W requested that terms of reference (TOR) for an environmental assessment of the hoped for 5,000 acre nucleus farm and processing plant be prepared and submitted to the Government of Sri lanka so that should an investor be identified, a rigorous and professional environmental assessment of the larger project could be prepared following this TOR.

These concerns were remedied by the Environmental Action Plan/[1] presented in September 1992 and agreement by ACDI that it would retain a consultant to prepare the requested TOR. With agreement to prepare the TOR and the Mission approved Action Plan, considered by at least one AID/W official to be a model which could be used for other missions, the draft environmental assessment for the nursery was approved by AID/W on September 17, 1992. As part of the negotiation and dialogue with AID/W environmental officials, ACDI agreed that the final environmental assessment, the action plan and the TOR would be presented in final form by ACDI/CSFD - Sri Lanka in due time.

Shortly thereafter, ACDI once again contracted the services of James Tolisano to prepare the TOR, which was subsequently prepared and submitted in draft form to the USAID Mission and the Central Environmental Authority in early December 1992 and once again in February 1993 after receiving comments and suggestions from both the Mission environmental officer and the undersigned.

Since September 1992, ACDI, through Agri-DEV, a non-profit Sri Lankan agribusiness development company created to channel CSFD activity funds, has developed the first 50 acres of the nursery and completed most activities outlined in the farm development plan and the environmental action plan. There have been <u>no</u> conflicts with elephants, water availability from the Dahamal Oya river hasn't become an issue, villagers have continued to access the lands beyond the nursery farm freely, chemical use by small farmers is a non-issue as no small farmers have been involved other than as workers on the

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[1] Flick, Robert C., "An Environmental Action Plan for the Proposed ACDI Pineapple Nursery Activity." ACDI, Colombo, Sri Lanka, September 1992.

nursery, wet lands have been protected as has the riverine forest. No borrow pits were developed nor used for on-farm road development and only EPA approved chemicals were used as required.

But events have now caught-up with the original intention of the nursery project. An investor has not been identified to undertake the hoped-for 5,000 acre nucleus farm and processing plant. Nor has an investor been identified for a much smaller 300 - 500 acre project to produce fresh fruit for export to the Middle East/Persian Gulf markets. As such, efforts to further develop the commercial pineapple industry in Sri Lanka and specifically in the Bibile region have now been largely abandoned by ACDI and Agri-DEV. The Government of Sri Lanka is considering alternate uses for the 50 acre nursery, among which is possibly turning it over to a cooperative or other farmer-owned enterprise or operating it themselves to distribute pineapple planting material amongst small farmers to cultivate in the traditional manner. In any event, it is highly unlikely that a large commercial pineapple farm will be developed in the Kotabowa region of the Moneragala District of Uva Province.

In accord with the agreements reached with USAID/SL and AID/W, ACDI herewith presents the final Environmental Assessment of the nursery farm, and, in separate documents, the action plan and the TOR.

Respectfully submitted,

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Chief of Party
Commercial Small Farm Development,
(an activity under the PVO Co-Financing II Project #383-1010)
September 28, 1993

EXECUTIVE SUMMARY

1.0 Purpose and Scope of the Environmental Assessment

The U.S. Agency for International Development (AID) has requested an environmental impact assessment (EIA) of a proposed 120 hectare commercial pineapple nursery farm to be developed by Agricultural Cooperatives Development International (ACDI) in the Bibile/Medagama region of the Moneragala District of Uva Province. The purpose of the proposed ACDI/USAID pineapple nursery farm is to facilitate commercial production of "Kew" variety of the smooth Cayenne pineapple. This EA has been scheduled to review the design of this proposed activity. This will enable ACDI to incorporate the recommended measures and procedures from the EA in order to ensure the environmental soundness of the activity.

An environmental assessment field review was carried out in Sri Lanka from March 16 - April 4. The field review was coordinated by Jim Tolisano, an ecologist and environmental assessment specialist, with technical support from the staff of ACDI. Data and analysis of results were compiled by the EA specialist. A scoping process included a formal meeting with concern Government of Sri Lanka (GSL), USAID, private sector, and non-governmental organization (NGO) representatives, and field interviews conducted in the proposed area of the activity.

2.0 The Proposed ACDI Pineapple Nursery Activity

The purpose of the proposed ACDI/USAID pineapple nursery farm is to facilitate commercial production of the "Kew" variety of the smooth Cayenne pineapple planting material. Only a very small acreage of this pineapple variety is now being grown in Sri Lanka. Commercial production will require the cultivation of much more planting material to enable growers to establish sufficient acreage. These materials will be made available to local growers, commercial or nucleus farms willing to proceed with commercial pineapple production.

The pineapple nursery will be implemented in three basic stages. During the first stage approximately 13.5 hectares of pineapple plants will be established in a total of 8 two-hectare blocks. Each block will be comprised of 30 planted beds, with walkways separating each bed. The blocks will be separated by roads approximately four meters in width, and designed to facilitate irrigation and materials transport (Figure 3). The second stage of the nursery will involve establishing an additional 60 hectares of pineapple plants, which will be planted in 24 additional blocks. The third stage of the nursery will involve establishing 40 additional hectares of pineapple plants in 16 blocks, for a total of 48 blocks.

3.0 Environmental Conditions in the Proposed Nursery Site

The proposed nursery site is located in Uva Province, approximately 25 kilometers northeast of the town of Badulla, and directly to the west of the Senanayake Samudra Sanctuary. The town of Bibile is approximately seven kilometers northwest of the site, and the town of Medagama is approximately six kilometers to the southwest (Figure 1). The proposed nursery will encompass approximately 120 hectares of land in a narrow rectangular area on the eastern bank of the Dahamal Oya drainage adjacent to the community of Kotabowa (Figure 2).

The proposed nursery is bounded on the east, north, and south by a mix of anthropogenic grasslands that are largely the result of persistent slash and burn ("chena") cultivation, some ruinate forest lands/[1], and some intact secondary tropical dry forests. These mixed grasslands and forest areas encompass approximately 3,000 hectares of public (GSL) lands, and extend to the borders of the designated wildlife sanctuary and national park.

4.0 Environmental Consequences of the Proposed Activity

In general, the environmental consequences of the proposed nursery will be minor in significance, and can be adequately addressed through implementation of several mitigative measures. The cleared lands and unvegetated areas in the nursery site could result in some soil loss and increased runoff, which will require adequate drainage facilities. The nursery should not adversely alter soil and water balances in the watershed area or immediately downstream from the site. However, diversions from the Dahamal Oya during low flow conditions may significantly reduce water supplies available to other users.

In general, the proposed pineapple nursery will not severely impact biological diversity in the area, and should not represent any threats to USFWS or GSL listed threatened or endangered species. There will be some loss of habitat through land clearing and cultivation. However, these lands do not represent very important habitat conditions for wildlife in the area, and should not result in any decline in population levels or diversity.

Conflicts between wildlife and nursery workers will likely occur. Principal confrontations can be anticipated with elephants, wild boar, deer, mongoose, primates,

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[1] "Ruinate" forest represents a forest type that has been significantly disturbed by human interventions, and has not yet developed to even a secondary recovery phase after initial clearing. These forests are usually distinguished by having very few scattered standing trees, usually of minimal economic value, and small diameter shrubs and trees that typically invade disturbed sites.

squirrels, rats, reptiles, and some bird species. Construction of a electric fence to enclose the nursery may discourage some, but not all of these species.

Development of the proposed pineapple nursery will result in some loss of tree cover in the area through land clearing and cultivation operations. However, the proposed nursery site does not represent intact secondary or primary tropical dry forest. Clearing this specific patch of land will not result in any loss of tropical forest cover.

The environmental consequences of the proposed pineapple nursery on agricultural production in the area should be beneficial. The nursery will encourage local crop diversification, and provide an impetus for pineapple production. The nursery can also serve as a model of appropriate soil and water conservation, and safe agrochemical use practices for local farmers. No restricted agrochemicals are to be used in the nursery operations.

While the project my result in some inmigration of population to the area, this may be offset by the creation of employment opportunities. Road infrastructure will likely be improved in the vicinity of the project, although the use of these roads may result in some localized air quality problems during the dry seasons, and will require adequate road drainage.

Developing a pineapple industry in the region could result in the diversification and eventual development of a major source of agricultural revenues for local residents, the private sector, and the GSL. This could produce the positive benefits of increased employment opportunities and income levels for some people, stimulation of associated service industries to support pineapple operations, and diversification of economic conditions.

5.0 Recommended Mitigative Measures

The following mitigation measures will enable USAID and the ACDI staff to offset, minimize, or avoid any possible adverse environmental effects from the proposed pineapple nursery activity. The measures presented are intended to ensure that land clearing, drainage and irrigation infrastructure, and agrochemical applications are carried out in a manner that respects existing wetlands, sustains aquatic systems for human and animal uses, and does not disrupt natural forests or wildlife habitats. The measures also encourage safe agrochemical uses, and include recommendations for site restoration after completion of the project.

1. ACDI should inventory and protect wetlands and springs found within the borders of the proposed nursery site. The inventory should result in (a) a map indicating the exact locations and area of all springs and wetland

areas; (b) estimated seasonal flow rates or water depth; and (c) a description of proposed protection measures.

2. ACDI should contract the services of a trained botanist to conduct random samples within the proposed nursery site to determine the presence of any rare, unique, threatened, endangered, or sensitive plant species.

3. Any road drainage and flood control measures constructed as part of the proposed nursery developed should be designed to withstand or facilitate the flows from a minimum of a 25 year storm event. Road drainage and flood control measures should also be designed to minimize or avoid the input of sediments to the Dahamal Oya or nearby wetlands and springs.

4. Road rehabilitation and maintenance activities may require the collection of soil and other materials from nearby borrow pits. These borrow pits for roadworks should be monitored by ACDI staff or other contracted services to ensure that no significant loss of agricultural lands or soil erosion results from the activities.

5. ACDI should map and designate on the ground a protected streamside forest area that extends a minimum of three chains (approximately 60 meters) from the east bank of the Dahamal Oya, and a minimum of one chain (approximately 20 meters) from both banks of the tributary to this river. Protection measures should ensure that all nursery development, operation and maintenance activities will not degrade or impair the ecological functions of these riverine forest communities.

6. ACDI should establish and employ non-lethal methods to discourage and disperse any TES wildlife species attempting to enter the proposed nursery site. If selected measures prove to be inappropriate or ineffective, then the project should contract the services of a Wildlife Management specialist with particular experience in the mitigation of elephant/farmer conflicts.

7. The proposed nursery will use agrochemicals which have been approved for General Use by the U.S. Environmental Protection Agency (EPA) and the Government of Sri Lanka (GSL), unless otherwise authorized. Agrochemicals are to be used only by applicators who have received instruction in proper handling and disposal practices.

8. Semi-annual water quality monitoring should be conducted at a point in the Dahamal Oya immediately upstream and immediately downstream from the proposed nursery site to establish baseline conditions and to detect the presence

of any toxic substances which may be entering the Dahamal Oya through nursery drainage water.

9. ACDI staff should monitor the quantity of water (flow rates) in the Dahamal Oya during any severe low flow conditions. If the amount of water being diverted for irrigation of the nursery is estimated to be greater than 50 percent of the total flows in the Dahamal Oya for a period of greater than five consecutive days, then the nursery should take the necessary steps to identify and implement a supplemental water supply source.

10. The ACDI staff should ensure that the nursery development, operations and maintenance will avoid any interference with traditional uses of the surrounding forest lands outside of the nursery area. If any conflicts over traditional land uses arise, then the ACDI project manager should negotiate mutually acceptable terms that will facilitate both nursery operations and traditional uses.

11. ACDI proposes to implement the nursery project in several stages. ACDI should conduct a simple and concise review of possible environmental impacts which may result from the implementation of the second and third phases of this project, prior to completing any additional field work. These simple environmental reviews should be conducted by an independent, objective individual or group with experience or training in environmental science or impact analysis.

12. ACDI should prepare a site restoration plan to ensure the natural recovery of the land if the nursery is discontinued at any future time.

One outcome of this activity could thus be the establishment of a large scale (2,000 hectares or greater), commercial pineapple nucleus farm on lands adjacent to or in the vicinity of the proposed nursery. Given the proximity of these lands to major wildlife sanctuaries and critical catchment areas, it is probable that such additional large-scale commercial developments could contribute to some significant adverse environmental changes. In general, these changes could include:

- loss of wildlife habitat and decline in the populations of some species, including some TES species;
- changes in runoff patterns, water and sediment balances, and microclimatic conditions;
- loss of some timber and non-timber forest products;
- expansion of chena cultivation in other undisturbed areas;

- increase in agrochemical uses in the area, and
- stresses on existing social infrastructure.

It may be possible to minimize or avoid some of these adverse impacts if careful environmental impact assessment and planning accompanies any proposed activity expansions. It is certainly essential that such an analysis be conducted prior to pursuing such large-scale land developments. This assessment and planning would require collection and interpretation of a considerable amount of data that are presently incomplete or unavailable, including information on wildlife populations and habitat conditions; water and sediment balances in the affected watersheds; and forest inventories. A description of the parameters that should be considered in the analysis of a larger scale commercial operation is included in Appendix E.

6.0 Required Assistance and Implementation Schedules for Recommended Measures

Depending upon the extent of outside technical assistance (TA) sought to implement the mitigative measures, the TA required to ensure the environmental soundness of the proposed ACDI Pineapple Nursery Project will not be excessive. Anticipated TA would include the following:

	Duration	Schedule
Wetlands Specialist	0.5 month period	Immediate
Botanist	0.5 month period	Immediate
Wildlife Specialist	0.5 month period	Depending upon incidents of wildlife conflicts
Environmental Impact Specialist	0.5 month period	Prior to implementation of each nursery phase

Other costs for the mitigative measures may require some minor, if any, increases in the current implementation budgets. It may be necessary to shift some resources from other activities to accommodate these changes.

1.0 Introduction

1.1 Environmental Process

1.1.1 Purpose and Scope of the EA

The U.S. Agency for International Development (AID) has requested an environmental impact assessment (EIA) of a proposed 120 hectare commercial pineapple nursery farm to be developed by Agricultural Cooperatives Development International (ACDI) in the Bibile/Medagama region of the Moneragala District of Uva Province. The purpose of the proposed ACDI/USAID pineapple nursery farm is to facilitate commercial production of "Kew" variety of the smooth Cayenne pineapple.

An environmental assessment field review was carried out in Sri Lanka from March 16 - April 4. The field review was coordinated by Jim Tolisano, an ecologist and environmental assessment specialist, with technical support from the staff of ACDI. Data and analysis of results were compiled by the EA specialist.

Three field visits were made to the site of the proposed nursery (Figures 1 and 2). Field visits were also made to other areas in the vicinity of the nursery in order to provide a thorough analysis of potential ecological impacts. The EA coordinator visited commercial farms, small farms and homesteads in conducting local field interviews. Approximately 100 farmers were interviewed, either collectively or individually. Interviews were also conducted in the villages of Bibile and Medagama with local artisans and shopkeepers, school teachers, health officers, and government personnel. Field reconnaissance work was also done in and around the perimeters of Gal Oya National Park, which is immediately to the east of the proposed nursery activity.

A scoping session was conducted in Colombo with key representatives from Government of Sri Lanka (GSL), AID, ACDI, and non-governmental organizations (NGOs). The key issues identified in local interviews and through the formal scoping session are summarized in Appendix A.

1.2 Environmental Policies and Regulations

1.2.1 USAID

USAID/Sri Lanka must follow a clearly defined set of environmental mandates. These procedures originate from the U.S. National Environmental Policy Act (NEPA), authorized by Congress in 1969, and subsequent guidelines developed by the U.S. Council on Environmental Quality (CEQ). The environmental policy for AID is specified in federal regulations CFR 22, Part 216. In summary, this legislation requires USAID/Sri Lanka to:

- Ensure that environmental consequences of AID-financed activities are identified and considered by both AID and the host country prior to a final decision to proceed, and that appropriate environmental safeguards are adopted within a project;

- Assist developing countries in strengthening their capabilities to appreciate and effectively evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement, and manage effective environmental programs;

- Identify all impacts upon the environment resulting from AID's actions, including those aspects of the biosphere including endangered species (Section 216.5) which are the common and cultural heritage of all humanity; and

- Define environmentally limiting factors which constrain development, and identify and carry out activities that assist in restoring the renewable resource base on which sustained development depends.

1.2.2 Government of Sri Lanka

The Government of Sri Lanka has a set of environmental regulations and procedures which mostly parallel those of AID. The 1988 amendments to Sri Lanka's National Environmental Act provide the regulatory basis for GSL EA regulations. The GSL and AID EA requirements have many similarities. Both procedures include Initial Environmental Examinations (IEEs) and EAs (called Environmental Impact Assessments or "EIAs" by the GSL), and the processes include scoping sessions, public notice and participation, and appropriate agency review and approval. The Central Environmental Authority (CEA) is responsible for implementing the GSL regulations.

The EIA process in Sri Lanka adheres to the following steps:

A. Project proponent submits the necessary preliminary information to the Project Approving Agency (PAA), which determines the environmental review requirements. AID is presently supporting the preparation of GSL guidelines for project proponents to submit this information.

B. The PAA reviews the preliminary information in an environmental scoping process to determine whether an IEE or an EIA is required. The scoping process can include representatives of the public (affected communities, NGOs), as well as all agencies involved in project decisions. The scoping process results in establishment of the scope of work for the required environmental document (IEE or EIA).

C. The project proponent prepares the environmental document in consultation with the CEA, the PAA, and whatever donor agency may be involved.

D. Upon receipt of the environmental document, the PAA publishes a notice in the Gazette and one national newspaper in Sinhala, Tamil, and English, offering the public 30 days to review the document and submit written comments.

E. An optional public hearing may be held on the proposed project after receipt of the environmental document.

F. Following review of the environmental document and the public comments, the PAA makes a decision to approve the project or not, which may be appealed for administrative review.

The GSL applies standardized environmental parameters for water quality, wildlife and other criteria in completing its environmental analyses.

1.3 The ACDI/USAID Proposed Pineapple Nursery Farm

1.3.1 Background Information

ACDI is operating in Sri Lanka under a cooperative agreement with USAID for implementation of the Commercial Small Farm Development (CSFD) activity. This activity occurs under the aegis of the PVO Co-Financing II Project (Project No: 383-0101).

The purpose of the PVO Co-Financing II Project is to assist Sri Lankan small-scale, low resource farmers to: a) increase, improve and diversify their production, first for the local market and later for export; b) learn new production and organizational technologies leading to new farmer organizations which are private, self sustaining and have a business focus, and/or linkages with reliable private sector agribusiness as an intermediate step; c) deal with the major obstacles and bottlenecks to increased farm incomes, specifically: obtaining scarce new planting materials, inputs and avoiding bottleneck related setbacks; d) demonstrate sustainable agricultural production techniques, including organic production, in order to conserve local soil and water quality and the environment in general, protect the health of farm families, and penetrate the organic export market.

The proposed nursery farm will be a sub-project under the CSFD. The Project Paper (PP) for the PVO Co-Financing Project indicates that environmental analyses of component activities will be undertaken on a case by case basis.

1.3.1 Overview of Pineapple Nursery Goals and Objectives

The purpose of the proposed ACDI/USAID pineapple nursery farm is to facilitate commercial production of the "Kew" variety of the smooth Cayenne pineapple planting material. Only a very small acreage of this pineapple variety is now being grown in Sri Lanka. Commercial production will require the cultivation of much more planting material to enable growers to establish sufficient acreage. These materials will be made available to local growers, commercial or nucleus farms willing to proceed with commercial pineapple production.

Recent analyses conducted by an international expert in pineapple production indicates that large scale commercial production of smooth Cayenne pineapple will probably require the establishment of a minimum of 2,000 hectares of pineapple plants (Smith, 1992). It is anticipated that this commercial production would occur as a nucleus farm immediately adjacent to the proposed ACDI commercial nursery.

ACDI intends to encourage this commercial development of a pineapple industry in Sri Lanka by establishing a 120 hectare commercial pineapple nursery farm in the Bibile/Medagama region of the Moneragala District of Uva Province. The nursery development will involve clearing presently uninhabited secondary forest and grasslands, road rehabilitation and construction, soil cultivation to a depth of approximately 0.5 meters, and construction of nursery beds and buildings. Planted materials will be irrigated using local surface or groundwater supplies, and foliar applications of plant nutrients will be done on a regular basis. Plant material may be dipped in fungicides and insecticides before planting and after harvest. Some weedicides, fungicides, and pesticides may be applied during production, although the exact quantity and frequency of applications will be defined by the actual extent of pest problems.

1.3.2 Activity Status

ACDI has identified the locally grown "Kew" pineapple variety to be a high yielding clone with excellent commercial possibilities. After reviewing the climatic conditions throughout the island of Sri Lanka, the ACDI consultant determined that the vicinity of Bibile and Medagama is well suited to ensure the sugar and acid levels necessary for high quality fruit production (Smith, 1992).

In addition, sufficient sparsely inhabited land area was identified near the community of Kotabowa, approximately eight kilometers south of Bibile to support both a nursery operation and possibly larger scale commercial operations adjacent to the nursery. This land area is located on the east side of the Dahamal Oya drainage, and extends from the stream bank to the boundaries of the Gal Oya National Park.

A design has been prepared for the nursery, complete with bed layout, planting and maintenance schedules. A nursery manager has been hired, and approximately 4 hectares (200,000 plants) of Kew smooth Cayenne planting material has been propagated in a small nursery near Aralaganwila for eventual transplant.

The pineapple nursery will be implemented in three basic stages. During the first stage approximately 20 hectares of pineapple plants will be established in a total of 8 two-hectare blocks. Each block will be comprised of 30 planted beds, with walkways separating each bed. The blocks will be separated by roads approximately four meters in width, and designed to facilitate irrigation and materials transport (Figure 3). The second stage of the nursery will involve establishing an additional 60 hectares of pineapple plants, which will be planted in 24 additional blocks. The third stage of the nursery will involve establishing 40 additional hectares of pineapple plants in 16 blocks, for a total of 48 two-hectare blocks.

1.3.3 Projected Outcome From Nursery Development

The first phase of the nursery can be established within the first year of operation. The second phase cannot be implemented until sufficient planting material has been produced, and is expected to be initiated approximately 9-10 months after implementation of nursery activities. The third phase can be initiated approximately 9-10 months after completion of the second phase.

The nursery will facilitate commercial production of Kew variety smooth Cayenne pineapples by producing sufficient quantities of plant material to enable local growers, commercial or nucleus farms to initiate commercial production. The need for the nursery is based on the determination that large quantities of presently unavailable planting material will be necessary in order to create opportunities for commercial pineapple production with the Kew variety in Sri Lanka.

A feasibility study has been conducted by ACDI to determine the commercial parameters of pineapple production and industrial processing in Sri Lanka and to ensure the viability of such operations in the international market (Smith, 1992). This study has indicated that commercial production of pineapple products in Sri Lanka could be economically viable with a minimum annual production of 100,000 metric tons. These pineapple fruits would be locally processed into frozen pineapple juice concentrate. Achieving these targets would require a minimum of 2,000 hectares of commercially grown pineapple with yields of at least 50 metric tons per hectare.

While it is believed that these targets could be met using a large number of outgrowers, the ACDI consultant has indicated that a fruit processor would be unlikely to

establish a processing facility until the minimum 2,000 hectares has been established. However, farmers will be equally hesitant to develop large scale outgrower operations until the market (processing facility) is certain. As a result, it is assumed that one outcome of this pineapple nursery will likely be the establishment of a large, contiguous pineapple nucleus farm. This nucleus farm would plant the minimum 2,000 hectares of Kew variety pineapple to enable a processing facility to begin production. The implementation of the processing facility would, in turn, motivate local outgrowers to begin large-scale production of additional pineapple materials. In a sense, then, this nucleus farm could be considered a potential fourth "stage" of the proposed pineapple nursery activity, although no USAID assistance is planned for the large commercial project.

At present, the assumption is that all of these activities - nursery farm, nucleus farm, processing facility, and outgrower program - would be carried out in the general Bibile-Medagama vicinity. ACDI is now carrying out further research to identify suitable lands for nucleus farm and processing plant development in the Bibile-Medagama area.

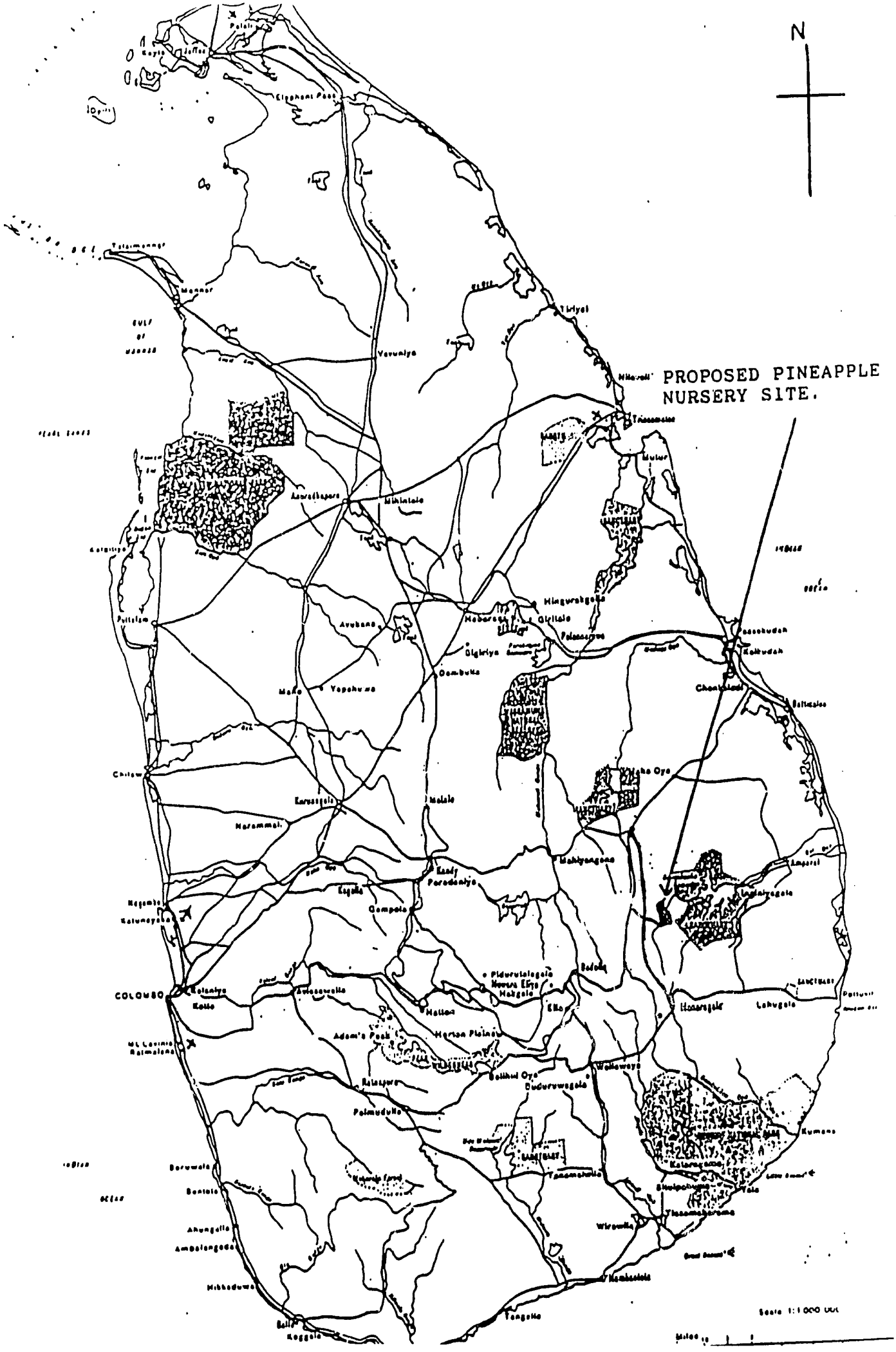
2.0 Description of the Affected Environment

The following review of the natural and social conditions in the Bibile/Medagama area will establish the "environment" potentially affected by the proposed ACDI Pineapple Nursery. The biophysical resources, including major river channels and floodplains, climate, soils, vegetation types, and biological diversity, represent the ecological foundation upon which the activity will be developed. The agricultural and socio-economic resources represent the ways in which human populations use and interact with these biophysical resources to sustain their livelihoods.

This analysis places a strong emphasis on concerns related to conservation of tropical forests and biological diversity, and agrochemical use in nursery operations. These emphases reflect a priority given to these issues through the U.S. Foreign Assistance Act (FAA), Sections 117, 118 and 119.

2.1 Geographical Area Affected by Proposed Nursery

The proposed nursery site is located in Uva Province, approximately 25 kilometers northeast of the town of Badulla, and approximately five kilometers to the west of the Senanayake Samudra Sanctuary. The town of Bibile is approximately seven kilometers northwest of the site, and the town of Medagama is approximately six kilometers to the southwest (Figure 1). The proposed nursery will encompass approximately 120 hectares of land in a narrow rectangular area on the eastern bank of the Dahamal Oya drainage adjacent to the community of Kotabowa (Figure 2).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PROPOSED PINEAPPLE NURSERY SITE.
Elephant Pass
Mannar
Trincomalee
Batticaloa
Kalmunai
Ampara
Hambantota
Tangalle
Matara
Galle
Kalutara
Colombo
Negombo
Puttalam
Chilaw
Anuradhapura
Vavuniya
Mullaitivu
Kandy
Nuwara Eliya
Badulla
Bandarawela
Ratnapura
Kurunegala
Polonnaruwa
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Batticaloa
Ampara
Hambantota
Matara
Galle
Kalutara
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Puttalam
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Batticaloa
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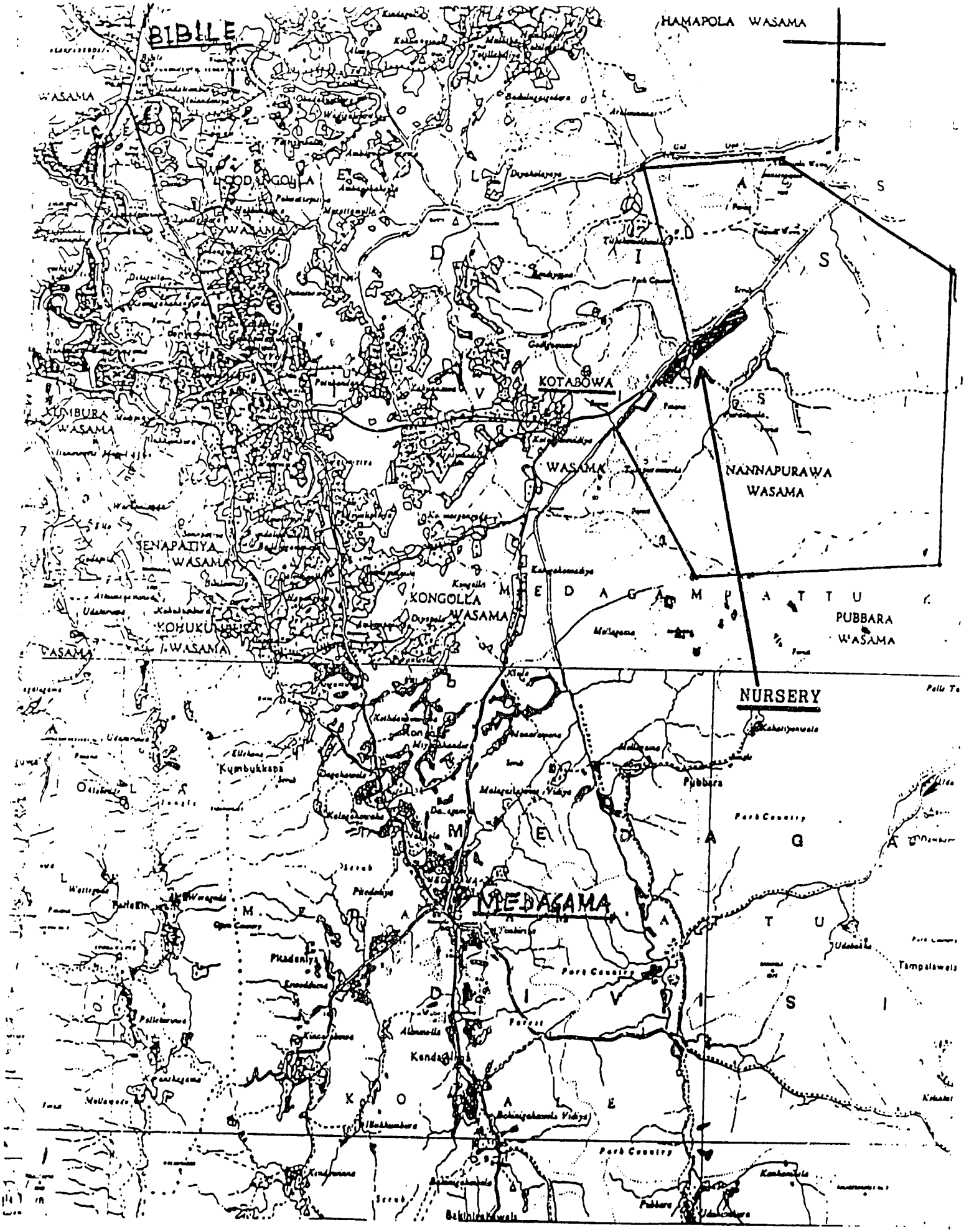

Figure 2. Location of Proposed Nursery in Relation to the Community of Kotabowa

The proposed nursery is bounded on the east, north, and south by a mix of anthropogenic grasslands that are largely the result of persistent slash and burn ("chena") cultivation, some ruinate forest lands/[2], and some intact secondary tropical dry forests. These mixed grasslands and forest areas encompass approximately 3,000 hectares of public (GSL) lands, and extend to the borders of the designated wildlife sanctuary and national park.

The area lies approximately 250 meters above sea level, with the higher hills near the Senanayake Samudra sanctuary reaching to roughly 600 meters.

2.2 Biophysical Resources

2.2.1 Soils

The soils of the Bibile/Medegama area can be summarized as of four types:

(a) A reddish brown and low humic grey soil is found in the higher areas of the hills, especially along the ridgelines. This soil has a low infiltration rate, and can be easily subject to erosion. However, the typical soil depth of 1 meter or greater, combined with adequate nutrient conditions, make this soil suitable for some crop production.

(b) Immature brown loams are found throughout this area. Although it has some erosion potential, the soil drains well, and is used for paddy production in many areas.

(c) Alluvial soils are found in the floodplain areas of the main drainages and their tributaries. These soils tend to be deep, with good drainage. Some of the soils in the proposed nursery site are made up of this alluvium.

(d) Low humic clays are found on the peneplains below the hill country and in the beds of abandoned tanks. These soils can also be subjected to flooding, although they have a high moisture retention level and are very suitable for paddy production. Most of the soils in the proposed nursery site consist of this higher clay content.

Without constructed drainage, the lowland humic clays and alluvial soils are generally saturated during the Maha (wet

---

[2] "Ruinate" forest represents a forest type that has been significantly disturbed by human interventions, and has not yet developed to even a secondary recovery phase after initial clearing. These forests are usually distinguished by having very few scattered standing trees, usually of minimal economic value, and small diameter shrubs and trees that typically invade disturbed sites.

seasons). The coarser higher elevation soils also tend to be saturated during the Maha, due to underlying impermeable layers, but dry out quickly in the Yala (dry season).

The results of a soil analysis for five samples collected from the proposed nursery site are presented in Figure 3. The sandy loam soil is slightly acidic, with low organic matter content, low phosphorous and nitrate levels, and no apparent problems with soluble salts or chlorides. Under cultivation, the infiltration and water holding capacity of this soil should be adequate for crop production. The cation exchange capacity and nutrient contents are also generally favorable for most crop production. Some fertilization would be necessary to supply phosphorous and nitrogen, and soil conservation measures would be required to minimize erosion.

2.2.2 Climate

The Bible/Medegama area experiences a tropical climate, with little variation in monthly temperatures or diurnal periods. Daytime temperatures are usually above 33 degrees Centigrade, and nightly lows are generally above 25 degrees Centigrade.

A northeast monsoon (Maha) occurs from October to February, and brings most of the annual rainfall. The southwest monsoon (Yala) occurs from June to September, and results in much less precipitation due to the orographic influence of the central highlands. Rainfall in the intermonsoon periods, if it occurs at all, can be caused by either convective or cyclonic storms. Average monthly rainfall, and collated monthly rainfall records for the Bibile area are shown in Figure 4. Annual rainfall records from 1972-90 indicates that dry year conditions would be on the order of 1200-1400 millimeters (mm), while wet year conditions could range from 2200-2500 mm. Average annual rainfall over the 19 year period of record is 1861 mm.

Average monthly evapotranspiration (ET) rates estimated using the Blaney-Criddle methodology suggest that during the months of March-September there can be an acute moisture deficiency for some plants.

Average Monthly Reference ET (mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
109	112	155	175	201	213	218	213	188	168	132	119

2.2.3 Hydrology

The proposed pineapple nursery will be located in the Dahamal Oya drainage basin, which has an estimated catchment area of approximately 117 square kilometers. The Dahamal Oya forms a tributary of the larger Gal Oya drainage, with an

REPORT NUMBER

W280-60

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SAMPLES SUBMITTED BY

CARL SPIVA

DATE OF REPORT 10-11-91

PAGE

SOIL ANALYSIS REPORT

(SEE EXPLANATION ON BACK)

THEO SHEET # 20 PACKET

SAMPLE NUMBER	LAB NUMBER	ORGANIC MATTER % RATE	ORGANIC MATTER ENR lbs/A	PHOSPHORUS P1 (West Bray) ppm-P RATE	PHOSPHORUS P2 $NaHCO_3$-P ppm-P RATE	POTASSIUM K ppm-K RATE	MAGNESIUM Mg ppm-Mg RATE	CALCIUM Ca ppm-Ca RATE	SODIUM Na ppm-Na RATE	pH SOIL pH	pH BUFFER INDEX	HYDROGEN H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	BASE SATURATION (COMPUTED) % K	% Mg	% Ca	% H	% Na
1	52269	1.2L	54	21H	15L	94	89	590	44	6.0		0.7	4.9	5.0	15.3	60.8	15.0	3.9
2	52270	1.4L	58	6L	11L	57	32	210	14	5.6		0.4	2.0	7.3	13.4	52.7	23.5	3.1
3	52271	1.3L	56	8L	14L	107	101	530	10	6.0		0.6	4.5	6.1	18.8	59.1	15.0	1.0
4	52272	1.5L	60	12L	14L	205	112	740	9	6.5		0.4	5.6	9.4	16.6	65.8	7.5	0.7
5	52273	1.2L	54	3VL	12L	140	92	360	9	5.9		0.6	3.6	10.0	21.5	50.4	17.0	1.1

VII IIA

SAMPLE NUMBER	NITRATE NO_3 ppm-NO_3-N RATE	SULFUR S ppm-S RATE	ZINC Zn ppm-Zn RATE	MANGANESE Mn ppm-Mn RATE	IRON Fe ppm-Fe RATE	COPPER Cu ppm-Cu RATE	BORON B ppm-B RATE	EXCESS LIME RATE	SOLUBLE SALTS mmhos/cm RATE	CHLORIDE Cl ppm-Cl RATE	MOLYBDENUM Mo ppm-Mo RATE
1	8L	20VH	0.9 L	10M	19H	1.0 M	0.5 L	L	0.3 L	18 L	
2	6L	19VH	0.6 L	10M	23H	0.8 L	0.4 VL	L	0.2 L	20 L	
3	9L	23VH	1.3 M	19H	46VH	0.8 L	0.4 VL	L	0.3 L	20 L	
4	13M	25VH	1.7 M	33VH	24H	1.2 M	0.4 VL	L	0.5 L	20 L	
5	8L	21VH	0.4 VL	26H	13M	0.8 L	0.5 L	L	0.2 L	21 L	

PARTICLE SIZE ANALYSIS

% SAND	% SILT	% CLAY	SOIL TEXTURE
69	12	19	SANDY LOAM
83	8	9	LOAMY SAND
77	12	11	SANDY LOAM
73	14	13	SANDY LOAM
[illegible]	[illegible]	[illegible]	SANDY LOAM

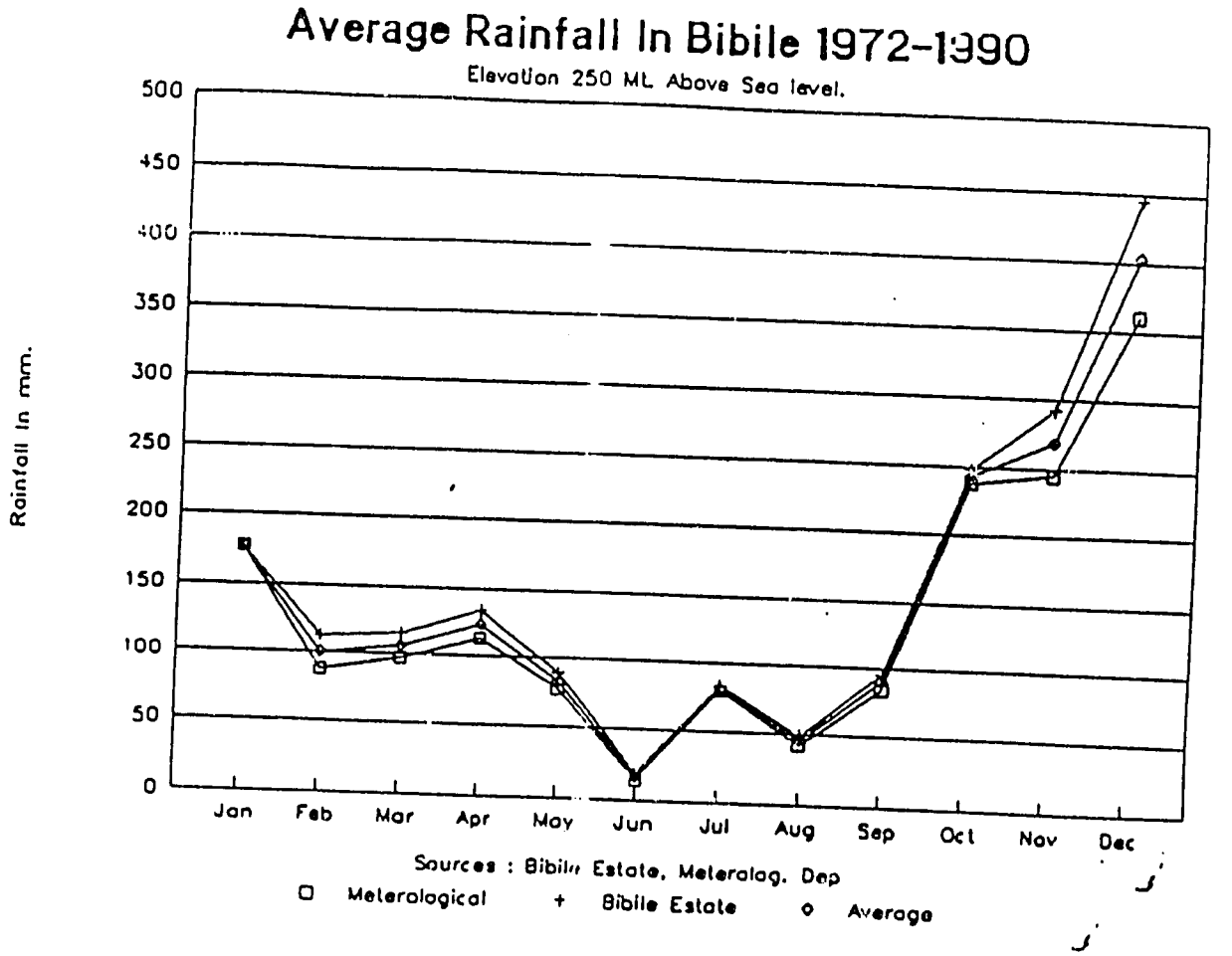
This report applies only to the samples tested. Samples are retained a maximum of thirty days after testing.

A & L WESTERN AGRICULTURAL LABORATORIES

By R. East
RICHARD EAST

* CODE - RATINGS VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), VERY HIGH (VH), AND NONE (N).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS PER ACRE OF THE ELEMENT(S) ETC.
**** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS PER ACRE #20
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS PER ACRE #20

Figure 3. Soil Analysis in Proposed Nursery Site



Rainfall In Bibile Estate
Elevation At Bibile Station : 252.7 at. A.M.S.L.

Source : Bibile Estate (JEDB) Office, Bibile

MONTH --> YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1972					12.446	29.210	29.718	8.128	97.790	294.132	261.874	428.244	1161.542
1973	41.910	50.292	142.240	14.224	32.004	38.100	77.470	27.178	58.420	183.896	344.424	636.270	1646.428
1974		91.186	70.612	226.314	187.452	10.160	66.040	9.144	83.566	56.896	178.054	427.228	1406.652
1975	127.508	105.410	147.828	126.238	50.292		132.842	141.224	129.794	98.552	168.148	354.584	1582.420
1976	351.282	31.496	66.548	207.518		24.384	37.592	138.176	88.138	85.344	234.442	322.580	1587.500
1977	38.608	96.266	106.172	70.104	90.678		52.070	22.352	90.170	361.188	228.600	467.106	1623.314
1978	73.660	116.840	82.804	62.992	130.048		34.290		22.098	236.982	225.044	404.114	1388.872
1979	26.760	9.820	7.300	13.110	82.320	55.480	93.560	5.060	18.360	416.440	501.210	326.400	1560.820
1980	186.450	4.130	12.040	359.340	109.450			13.160	58.410	299.490	451.960	268.740	1762.170
1981	112.160	380.180	78.350	138.280	62.400	9.160	305.460	22.060	43.170	331.720	396.300	344.440	2223.680
1982	12.020		114.150	68.180	201.300	30.100	7.020	5.060	103.530	272.990	409.960	570.950	1795.260
1983	114.200	49.800	25.500	24.200	78.400	25.800	11.800	40.700	36.600	293.300	200.600	868.600	1769.500
1984	368.500	528.900	239.100	131.300	98.700		160.900	20.100	220.100	207.100	252.800	202.900	2430.400
1985	295.000	218.500	226.800	66.600	3.900	39.500	55.100	125.300	116.600	116.600	149.900	463.000	1876.800
1986	380.700	109.700	302.500	178.000	151.700		78.900	29.600	31.100	369.900	217.400	636.500	2486.000
1987	338.700	76.300	177.300	288.700	127.300			13.800	140.300	579.700	123.600	309.700	2175.400
1988	167.100	118.100	221.800	271.050	118.900	0.700	203.400	124.800	78.700	161.000	405.400	541.800	2412.750
1989	296.000	16.900	80.500	216.100	89.500	90.300	184.900	54.300	283.600	177.000	515.800	267.700	2272.600
1990	425.200	148.500	101.900	90.400	61.000		43.100	122.300	121.200	169.200	297.800	630.300	2211.500
1991	433.000	93.200	129.500	81.000	224.500	20.600	17.000	12.000					
Total	199.408	112.276	116.647	131.633	95.615	23.343	84.040	46.722	95.876	247.970	292.806	445.850	

Figure 4. Average Rainfall in Bibile

estimated catchment area of 188 square kilometers below the confluence of the two rivers.

Average estimated monthly flow rates in the Dahamal Oya range from a low of 1.1 cubic meters per second (cms) in the months of June and July to a high of 16.1 cms in January. Gauged flow records in the Gal Oya indicate that typical monthly flows can range from a low of 1.4 cms (August 1991) to a high of 52.9 cms (January 1986). Gauged and average monthly flows, and annual hydrographs for the two rivers are shown in Figure 5.

Residents indicate that both rivers tend to be perennial, although during some drought periods the flows have been very low. Flows in the Dahamal Oya at the proposed nursery site during the current drought period were estimating using the Manning equation to be less than 1 cms.

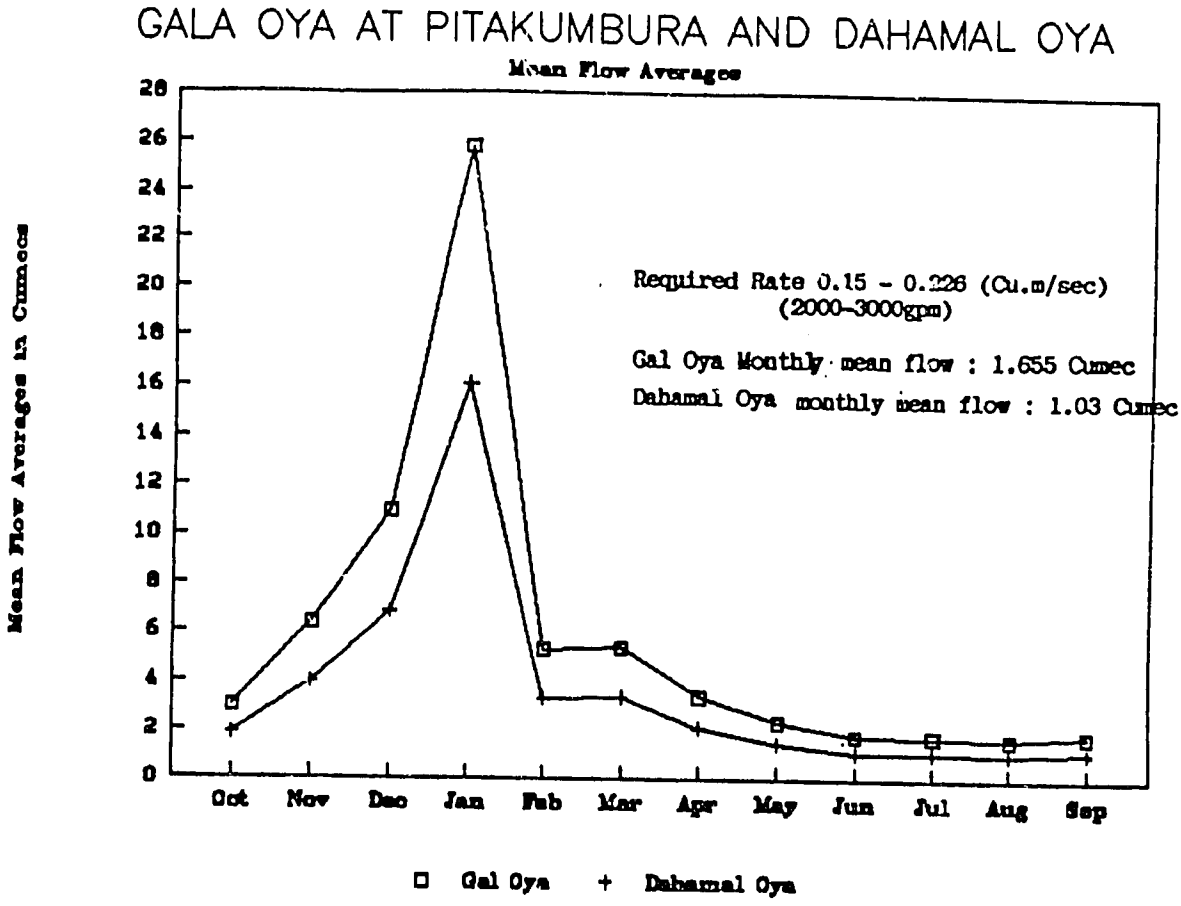
Potable water supplies in the area are primarily obtained through open, hand-dug wells, or, in some cases, sealed tube wells. The yield from these wells is apparently excellent, and residents report little seasonal variation in water table levels. Typical water table levels in the wet season are approximately 1-3 meters, and during the dry season can range from 3-5 meters. Approximately one-third of the total population obtains its water supplies from private wells, with an additional one-third relying on public wells. The remainder of the population collects water from canals or other waterways.

Very little baseline data exist on water quality conditions for both surface and groundwater in the area. Recent tests conducted by ACDI indicate that water quality downstream from the proposed nursery site contains high bacterial counts and do not meet the bacteriological requirements as specified in Sri Lanka for potable water. Inadequate data exist to assess the suitable of these waters for irrigation purposes.

The Dahamal Oya drainage is subject to periodic flooding. Unfortunately, no reliable data exist to quantity or estimate probable flood stages from storms of various return periods. An improved data base and more accurate modeling of these flood stages is probably warranted to determine flood levels during various storm duration scenarios.

2.2.3.1 Floodplain Ecosystem Characteristics

The lands on both banks of the Dahamal Oya and Gal Oya represent important floodplain ecosystems. These lands are typically seasonally inundated, with completed saturated soils for periods ranging from several days to several months. These seasonal wetlands (villus) and riverine forests represent important spawning grounds and habitat for a wide variety of aquatic organisms, including some fish species uniquely adapted to floodplain conditions.



Gal Oya at Pitakumpura
monthly mean flow averages
in cumecs (cubic meters per second)

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
84/85	2.698	6.433	4.767	8.969	8.377	6.360	4.287	1.776	1.833	1.797	1.843	1.853
85/86	1.853	3.445	13.880	52.937	7.773	14.413	3.982	3.021	1.921	1.800	1.655	1.569
86/87	3.240	2.454	12.006	14.995	6.524	5.249	5.051	2.918	1.773	1.502	1.514	1.591
87/88	6.783	4.083	7.599	5.011	2.318	3.489	2.915	2.384	1.754	1.904	1.875	2.351
88/89	1.901	4.535	11.896	20.440	2.735	2.115	2.505	1.939	1.695	2.129	1.591	1.918
89/90	2.117	19.200	9.700	50.970	4.702	2.811	2.496	2.159	1.706	1.714	1.714	1.904
90/91	2.380	4.510	16.780	27.060	4.560	3.180	2.380	2.130	1.800	1.440	1.390	1.510
Total	20.972	44.645	76.630	180.382	36.989	37.617	23.646	16.377	12.482	12.286	11.582	12.696
Gal Oya Average	2.996	6.378	10.947	25.769	5.284	5.374	3.378	2.339	1.783	1.755	1.655	1.814
Dahamal Oya*	1.87	3.98	6.83	16.09	3.3	3.35	2.11	1.46	1.11	1.1	1.03	1.13

* Estimated in proportionate to the catchment area
Gal Oya catchment area = 188.16 sq.km
Dahamal Oya catchment area = 117.45 sq.km

Figure 5. Hydrologic Characteristics of the Dahamal Oya

The wetlands and riverine forests also act as an important filter of many sediments, minerals, and other substances that may be moved by surface water overland towards streams and rivers. These materials are slowed by wetland vegetation, and settle into heavy clay soils. The vast surface area of clay soil particles adsorbs many of these materials, and some wetland vegetation will actually take the materials up through root action. In this manner, substances which may be toxic to aquatic organisms can be filtered and prevented from contaminating surface waters.

Aquatic organisms inhabiting these riverine forests, wetlands, and within the rivers, themselves, represent an important food source supporting elaborate food chains in terrestrial ecosystems. This is particularly true of the diverse macro-invertebrates found in these floodplain ecosystems. The role of these macro-invertebrates is roughly equivalent to that of plankton in ocean ecosystems. The true measure of biological diversity in a site is typically reflected in the diversity and abundance of aquatic organisms found in the floodplain ecosystems.

Distinct from many other sites in Sri Lanka, the usual wetting patterns in these floodplains has not been altered by upstream dam and drainage construction. While these floodplains have been disturbed in some locations through chena cultivation, most of the riverine forests and villus in the vicinity of the proposed pineapple nursery appear to be reasonably intact. It is assumed that aquatic populations are well balanced and abundant in this area, given the minimal disturbance. Unfortunately, few data exist to indicate the present population status of such indicator species as macro-invertebrates or to quantify this assumption.

2.2.4 Biodiversity

2.2.4.1 Vegetation

The primary vegetation found in the vicinity of the proposed nursery site is a mix of Damana Grassland and some ruinate forests. Intact Tropical Dry Forests can be found to the east of the proposed nursery site, but no intact forest communities are evident in the nursery site, itself. Intact riverine forests line the banks of the Dahamal Oya to the west of the proposed nursery site, and one of its tributaries crossing the northern quarter of the site. The grasslands and ruinate forests have been subject to periodic slash and burn cultivation ("chena"), which has been the principal factor influencing vegetation characteristics.

Damana Grasslands are typically defined as dry, open areas with scattered patches of forest trees. The dominant grass species in this community is locally known as Iluk (Imperata cylindrica). This is a persistent, fire-induced grass that is largely palatable as fodder only in its early growth stages, and is consequently frequently burned to renew the shoots.

The grass is widely used for roofing and other weaving. Less common, but evident in these grasslands is the mana grass (Cympogan nardaus), which has slightly more value as a fodder crop.

Virtually all of the valuable commercial tree species have been removed from these lands, and the remaining trees are fire resistant species which may be used locally for firewood and non-timber forest products. A sample inventory of a 0.5 hectare block at the northern edge of the proposed nursery site suggested that typical tree densities range from 20-75 trees per hectare, which would be far less than the typical stocking density of a mature secondary dry tropical forest community.

The ruinate forests have been extensively high-graded, whereby all of the commercially valuable tree species have been removed and the less valuable species left intact. These forests are open, with Iluk undergrowth, and some evidence of past chena cultivation. The forests are principally used as a source of firewood, some collection of non-timber forest products (principally medicinal plants and craft materials), and seasonal grazing of animals.

The intact forests to the east of the site are representative of the former natural forest type in the vicinity of the proposed nursery. Tree cover is the dominant vegetation, with characteristic species including:

Satin (Chloroxylon swietenia)
Kumbuk (Terminalis arjuna)
Bulu (Terminalia chebula)
Palu (Manilkara hexandra)
Demata (Gmelina asiatica)
Huri (Albizzia chinensis)
Rukattana (Alstonia scholaris)
Dunumadala (Stereospermum peronatum)
Mee (Maduca longifolia)
Milla (Vitex pinnata)
Kahata (Caeya arborea)
Wira (Drypetes sepiaria)
Kon (Schleichera oleosa)
Halmilla (Berrya cordifolia)

Tree heights in these intact forests are typically less than 15 meters in height, with small crowns. Several species can produce marketable timber, and some non-timber forest products are collected in these forests.

2.2.4.2 Fauna

No accurate inventories of mammals, birds, fish, reptiles and amphibians, or invertebrates have been conducted in this area, and the limited time available to prepare this EA prevented the collection of such data in the field. Most knowledge of fauna population and habitat characteristics is

based on the experience of local residents involved in livestock grazing, chena cultivation, and the collection of timber and non-timber forest products in the area.

Apparently, the habitat can still support stable populations of large mammals, including several threatened, endangered, or sensitive (TES) species. Habitat conditions in the lands to the east of the proposed nursery site appear adequate to support a typical fauna characteristic of this ecosystem, which would suggest that perhaps 60 mammal species, at least two amphibian and 20 reptile species, and more than 100 bird species should be resident or migratory in the area. Residents reported the occurrence of several mammals in the area, including herds of elephant, wild boar, spotted deer, sambhar, sloth bear, and leopard. However, locals indicated that very few fish species are found in the river, and some occur only during flood periods.

It is unknown how many of these species inhabit the proposed nursery site, but, given the degraded forest conditions, probably very few. However, many of these species will move through or utilize the resources of this site on occasion. Site disturbances will likely result in future wildlife/nursery encounters as these animals attempt to follow former movement patterns.

2.2.4.3 Habitat Conservation Measures in Affected Environment

Approximately five kilometers to the east of the proposed nursery site lies the Gal Oya National Park and Sananyake Samudra Sanctuary. This protected area includes a large reservoir at the outlet of the Gal Oya irrigation system.

The protect area includes intact forest lands in varying stages of vegetation succession, and some grasslands. Some of these forest lands have been selectively harvested in recent times, and some past chena cultivation is evident in the area. For the most part, however, the forests in this protected area are reasonably intact, and representative of a mature tropical dry forest community.

The grassland communities appear to be largely anthropogenic (e.g. created by human actions), and are probably the result of past chena cultivation. The dominant species in many of these grassland areas appears to be Imperata cylindrica (Illuk), which is of low nutritional value and largely palatable only in its early growth stages. The grass is consumed by herbivores, including elephant, wild buffalo, and deer, although all of these species would select more palatable and nutritious grasses if available.

The grassland areas have created an extensive network of "edges" in and around the park. These edges represent boundaries between the dense forest vegetation and the more

open, park-like grasslands. A high degree of edge is generally supportive of more diverse and abundant wildlife populations, although too much edge eliminates important habitat needs. Also, not all species are fond of this edge effect. Edges can also represent pathways for invader plant species to infiltrate and dominate an ecosystem. The Illuk grasses are an example of this kind of invasion.

In addition to the very large Senanayake Samudra reservoir, several small tanks and wet areas exist in the park, although some of these are reportedly in poor condition due to overuse by wildlife and establishment of invader plant species.

Still, the Gal Oya National Park represents some of the most viable and important wildlife habitat remaining in the Moneragala region. Although no recent wildlife surveys or habitat inventories have been conducted, it is estimated that the park supports a population of approximately 300 elephants (Department of Wildlife Conservation, 1990). All of the Threatened and Endangered species listed in Section 2.2.4.4 could be found within the park.

2.2.4.4 Threatened, Endangered and Sensitive Species

Nine species listed as threatened, endangered or sensitive to environmental changes (TES) by the USFWS or the GSL can be found in the general vicinity of the proposed pineapple nursery site. These species include the following:

Asian Elephant(E)	Elaphus maximum
Leopard(E)	Felis bengalensis bengalensis
Entellus Langur(E)	Presbytis entellus
Purple-faced Langur(T)	Presbytis senex
Toque Macaque (T)	Macaca sinica
Red-faced Malkoha (E)	Phaenicophaeus pyrrhocephalus
Mugger Crocodile (E)	Crocodylus palustris kimbula
Indian Python (E)	Python molurus molurus
Bengal Monitor (E)	Varanus griseus

An additional species found in the area which has not yet been formally listed, but which is and sensitive to habitat disturbances. and apparently now occurring only in very low numbers, is the Sloth Bear (Melursus asiatica).

The long term viability of all of these species in Sri Lanka is principally threatened or endangered as a result of loss of available habitat for feeding and reproduction.

Only the Bengal Monitor and Macaque are likely to be residents in the immediate vicinity of the proposed nursery site. The other species inhabit areas on the perimeter of the site, in the Nilgala Corridor, and the Gal Oya National Park, or in other remnant undeveloped forest lands.

According to local reports, all of these species will occasionally move through the riverine forest to the west of

the proposed nursery site, and sometimes can be found in the site itself. Local chena farmers report that herds of as many as 50 elephants have moved through the areas immediately to the east of the site. Seasonal livestock camps established approximately two kilometers to the east of the site report frequent encounters with leopards, and indicate that bands of up to five leopards at a time will hunt in the area. Human/wildlife encounters and problems are frequently reported, principally in regards to elephants. Settlers reported numerous elephant attacks to humans, and some of these attacks have resulted in loss of human life.

The TES species in this area represent important indicators of the resilience or "health" of the ecosystem. The very presence of TES species typically indicates a degradation or imbalance in the food chain of the overall ecosystem, and further population declines within these species would represent a significant sign of ecological stress. This is true even though some TES species typically maintain very low population levels even under the best of conditions (leopards and bear, with their large territorial requirements, are good examples). As a result, accurate estimates of the population levels and densities of these TES species within a particular ecosystem will provide a good indication of the site's ecological health. Unfortunately, no good data exist on any of the TES species which occur in the Bibile/Medagama area to indicate this ecological status.

2.3 Agricultural Resources

2.3.1 Crops and Livestock

Chena Cultivation: The principal crop being grown in and adjacent to the proposed nursery site is paddy. A variety of fruits and vegetables may also be cultivated, depending upon rainfall and soils. This cropping pattern is typical of other chena cultivation practices in the area, and is usually seasonal in nature, and dependent upon adequate rainfall.

The chena cultivation typically involves manually clearing the land of the larger trees, and then burning the area to remove most of the remaining native vegetative cover. The field is then cultivated for one or more planting seasons, before being left to go into a fallow cycle. During the fallow cycle the farmer will move on to clear and cultivate new lands, eventually returning to the initial chena site after a period of years.

In a traditional chena field, many native trees would be left standing in semblance of a selectively logged forest. These standing trees would ultimately serve as a seed source to encourage forest recovery after the cultivation cycle is completed and the land returned to fallow. Studies of chena fields conducted in the 1700's indicated that tree species diversity and density was usually higher during the fallow period after chena cultivation than before.

Unfortunately, at the present time most chena cultivators have significantly shortened the fallow period between cultivations due to increasing land pressures. This results in more frequent burning of sites, and limits, or in some cases, eliminates recovery by tree species. The more frequent burning encourages fire-tolerant invader species, and reduces the fertility and water holding capacity of the soils. Further, the traditional practice of leaving a diversity of tree species intact on the site appears to have given way to a tendency to only leave species with marginal values, and which represent minimal conflict with subsequent cultivation.

Other Cultivation: Cropping patterns in the general Bibile and Medagama areas indicate that several crops are being grown for commercial and subsistence uses. Estimated acreage for crops in the entire Medagama division include the following:

Variety	Hectares	Production (tons)
Chili	30	26
Maize	322	624
Kurakkan	217	44
Green Gram	59	25
Cowpea	115	31
Coffee	250	n/a
Pepper	53	n/a
Cocoa	6	n/a
Rubber	n/a	n/a
Coconut	550	n/a
Cashew	26	n/a
Manioc	240	11,808
Sweet Potato	47	1,450
Paddy	1,537	3,576

Animal husbandry is also important in the area. Although the population of cows is very high, estimated at 9,000 in the Medagama division alone, the collection of dairy products is low and breeding practices largely ignored. Inadequate veterinary services, poorly bred animals, inadequate collection and marketing services, and low farmer interest have been attributed to the poor dairy production. The climate is favorable to goat production, and an estimated 750 animals are kept in the Medagama area. Poultry production is also important, particularly in homestead operations.

Fish harvests occur both in local reservoirs and private ponds. The annual catch can be as much as 20,000 metric tons, although actual catch is probably much lower. Fish production and harvests represent an important, if underutilized, source of protein for local residents.

2.3.1.1 Agrochemical Uses

While many of the farmers in the Bibile/Medagama do use agrochemicals, particularly on lands intended to produce market crops, no farmers cultivating land in or adjacent to

the proposed nursery site report the use of agrochemicals in their plots. There will be some agrochemical use in the proposed pineapple nursery, itself, and this is discussed in Chapter Three.

2.3.2 Land Use Characteristics

The vast majority of families living in this area maintain some form of agricultural production on their lands, principally paddy cultivation. Most individual plots are separated into commercial (market crop) lands and homestead (subsistence) lands. Commercial fields will usually be devoted to one or two principal crops which are cultivated intensively. Homestead areas are typically much more diverse, and include a mix of perennial tree crops, low growing shrubs, field crops, and domestic animals on small areas of usually less than 0.5 hectare.

Approximately 68 percent of the lands in the Medagama division are in some form of agricultural production, or are considered suitable and appropriate for agriculture. Approximately 18 percent are in homestead gardens, six percent in paddy, and 27 percent still largely undeveloped. Some of this undeveloped land is actually being used for seasonal chena cultivation at present.

Approximately 20 percent of the lands in the Medagama division are in some form of forest cover, with an additional 11 percent in grassland or ruinate forest. The land in and adjacent to the proposed nursery site is in grassland and ruinate forest, and is principally being used for chena cultivation.

2.4 Socio-Economic Resources

2.4.1 Population Characteristics

The population in the Medagama division was estimated to be 25,592 in 1988, which represents an average density of 93 per square kilometer. The population in the Bibile division was estimated at 29,386, which represents an average density of 50 per square kilometer. However, in the Bibile division less than 2,000 people live in 75 percent of the land area. This pattern is equally true in the Medagama division. The majority of the population is under the age of 25, and the estimated population growth rate in the area is more than 2.5 percent.

Approximately 5,118 families are reported to be living in 137 villages in the Medagama division, and a roughly similar number of families were reported by local residents in the Bibile area.

2.4.2 Transportation Networks

A main road extends from Bibile to Moneragala, and numerous secondary roads run off of this road to smaller communities and outlying areas. The total length of primary and secondary roads in the Medagama area is approximately 60 kilometers. Main roads also run from Bibile to Badulla, and a secondary road that is nearing completion will connect Bibile with the main road to Kandy.

A sealed road runs from the Bibile-Medagama road to the community of Kotabowa adjacent to the proposed nursery site. This road then turns into a dirt track and crosses the Dahamal Oya, extending approximately seven kilometers towards the Nilgala corridor.

2.4.3 Principal Economic Activities

Recent estimates suggest that the unemployment rate in the Bibile/Medagama area is approximately 75 percent. However, this figure does not take into account market agricultural production, which is practiced by virtually all residents in the area. This characteristic is important to note, since several farmers interviewed reported typical monthly earnings that would be greater than those of an average mid-level government employee. Yet these same farmers list themselves as "unemployed".

Small scale market agriculture represents the primary commercial activity for most residents in the area. Approximately 4200 hectares of paddy was harvested in the Bibile/Medagama area in 1989, with an estimated yield of approximately 6500 metric tons. At typical market prices in the area, this harvest would have a gross value of approximately 60 million rupees (U.S.$1.5 million). Several farmers interviewed indicated that they could gross between 11,000-15,000 rupees (U.S.$268-366) per 0.4 hectare of paddy. Some farmers indicated that two harvests per year are possible, although other farmers felt that only one annual harvest is reliable.

Very limited area of other export and domestic crops are grown in the area, and small local produce markets exist in Bibile and Medagama. Some effort has been extended to increase the area of commercial crop production in the region, particularly emphasizing tree crops (rubber, cocoa, citrus). This has only resulted in several small plantations at present.

Cottage industries include cane and other fiber weaving, brick-making, pottery, spinning, blacksmithing, woodworking, and metal-working. These industries supply agricultural and non-agricultural implements, tools, and basic subsistence needs. Retailers of basic agricultural supplies, including fertilizers and agrochemicals, also are in place in these communities.

Rural households depend on a highly diversified range of activities for their basic needs. Homestead plots of less than 0.5 hectare are maintained for fruit, vegetable, poultry, livestock, and other product needs. Some of these homestead plots are also used to produce crops that are sold commercially.

Collection of non-timber forest products, including medicinal plants, craft and household fibers, firewood, and foods, represents an important supplemental income activity for a small percentage of the population. However, these activities were identified as important for the majority of settlers residing in and around the proposed pineapple nursery site. One local farmer/gatherer stated that a recent collection trip undertaken by 20 local farmers yielded a net profit of 40,000 rupees (U.S.$975) which was equally divided among the 20 people.

There do not appear to be many opportunities in place for women or landless residents to become more self-reliant through the promotion of entrepreneurship. There were several women-operated businesses observed in the commercial centers, although the total number in relation to all other businesses was low. Part of this is probably due to the fact that much of the population is comprised of young settlers, with few extended families. Women with children have little time available at present to devote to entrepreneurial efforts. This situation may change as families mature, and extended families develop. Also, most women in farm households work full-time in planting, maintaining, harvesting, and packaging (if necessary).

Economic activities result in many direct and indirect environmental impacts. Agricultural production has changed a majority of the land base in the area from forest or fire-induced grassland to cultivated fields. Fuelwood collection is further depleting some of the forest areas. Brickmaking has become an important industry, particularly in some of the floodplain areas. Brickmakers in nearby areas indicate that approximately two cubic meters of wood are used to temper each 1,000 bricks fired. Rattan collectors are also having a significant impact on the understory in the riverine forests through uncontrolled wild plant harvests.

2.4.4 Health Conditions

An Ayurvedic hospital is located in the town of Medagama, approximately seven kilometers south of the proposed nursery site. Other traditional and western medical workers and public health professionals are available in the area, although few in number. Public heath facilities operated by the GSL are located in the communities of Bibile and Medagama.

The epidemiological profile of the area is representative of most rural tropical environments. Diarrhoeal diseases with commonly undiagnosed etiology is highly prevalent. Hookworm

and ascarides are common helminthic infections. Giardiasis is also common, along with Entamoeba histolytica. Numerous cases of typhoid fever have also been reported.

Malaria is endemic, and reported to be chronic by many residents. About 20 percent of the population are subject to malaria, and incidents appear to have been increasing in recent years. Intact floodplain ecosystems are generally protective against malaria. Malaria infections are usually more common in areas outside of active floodplains. The annual flooding provides a natural control of malaria: the silty flood waters are unfavorable to the breeding of mosquito vectors; the extent of the breeding edge is reduced; and the rising of the water table above the aquatic vegetation exposes the larvae to attacks from fish and other predators. While flooding destroys mosquito breeding grounds, improper drainage encourages them.

Mosquito-borne encephalitis is probably also resident in the area, although no recent cases were specifically reported from Bibile or Medagama. Dengue fever is also prevalent in the area.

Approximately 25 percent of the population obtain their water from unprotected sources, and more than 40 percent lack sanitary lavatory facilities. However, home construction and living conditions appear, in general, to be of reasonable quality, and do not appear particularly conducive to poor health conditions. Health workers have instead indicated that the primary causes of disease in the area are poor sanitation and inadequate attention paid to health concerns by the local population. Increased health education has been cited as an important prerequisite to improved health conditions.

2.4.5 Cultural Resources

A famous temple site is located close to the town of Medagama, and numerous ancient tank (reservoir) sites are scattered throughout the area. No significant cultural or archeological sites have been identified in or adjacent to the proposed pineapple nursery site.

2.5 Energy Supply and Demand

The primary energy materials being used in the Bibile/Medagama area are electricity and kerosene for lighting, and fuelwood and kerosene for cooking. Gasoline and diesel generators and motors are also abundantly used for supplemental electricity, farm machinery, and transport. Domestic animals, principally buffalo, are also used extensively for farming operations. While the elephant has been domesticated in several areas of Sri Lanka, it was not observed to be in common usage as a farm animal in this area.

Recent data on energy use patterns were not found to be available. Field observations indicate, however, that

fuelwood is a primary energy source for most residents, both in the settled villages and on the farm homestead.

While fuelwood supplies from remaining woodlands are still available for most farmers, some families are being forced to travel farther and farther to collect wood, or to purchase fuelwood with very limited available capital. Studies in similar areas of Sri Lanka have estimated typical annual family consumption rates of approximately four cubic meters of fuelwood. At this use rate, and assuming an estimated total population of 50,000 in the Bibile/Medagama area, it is likely that fuelwood shortages could occur, particularly in the more densely populated areas, in the near future. This could lead to increased pressures on the forest lands in the vicinity of the proposed nursery site.

3.0 Environmental Consequences of Alternative Strategies

Two alternative scenarios were considered for the ACDI Pineapple Nursery Project: (1) to proceed with the proposed nursery development as presently defined, or (2) to take no further action on the ACDI proposal. The probable environmental consequences of each alternative scenario have been estimated using available data and field assessments of present conditions in the Bibile/Medagama area. The preferred alternative is then identified based on a cumulative analysis of the predicted environmental consequences.

3.1 Environmental Consequences of First Alternative

Chapter Two indicated that the physical and biological environment in the proposed nursery site is largely comprised of a disturbed dry tropical forest ecosystem, and undisturbed tropical lowland riverine forests. This site lies adjacent to a mix of similar disturbed and undisturbed dry tropical forests. In general, the land clearing, cultivation, and maintenance of a pineapple nursery operation will result in some changes to hydrologic processes, and some loss of ruinate forest cover. However, there are no indications that the proposed ACDI Pineapple Nursery Project will result in significant degradation of the surrounding ecosystem. The potential adverse environmental problems which could result from the project can be adequately managed through mitigative measures applied during the life of the project. These potential adverse problems are described below, and appropriate mitigative measures are presented in Chapter Four. More significant environmental concerns may become apparent if the proposed nursery evolves into a large scale commercial pineapple plantation. These concerns, and suitable analyses appropriate to address them, are also described in Chapter Four.

3.1.1 Impacts to Biophysical Resources

3.1.1.1 Soil and Water Resources

The proposed nursery is located in the Dahamal Oya catchment basin, approximately 500 meters upstream from the confluence with the Gal Oya drainage. The Dahamal Oya catchment is approximately 45 square miles in total area, and the proposed nursery represents an extremely small percentage of the watershed area. As a result, the influence of the nursery activities on the water balance in the catchment area will be insignificant. There may, however, be some slight changes in water balance conditions on a site-specific basis.

The actual impact of the project on microclimatic conditions, water budgets, and soil loss rates will be directly influenced by pineapple planting densities and total vegetative cover in the nursery site. The proposed project design indicates that planting density will be very high, with approximately 87,822 plants per hectare. Plants will be set in beds, in which three rows of plants will be established. Spacing from plant to plant is 28 centimeters, and spacing between rows will be 15.33 centimeters. Since plant production in the beds will be permanent, with no unproductive fallow periods, the vegetative ground cover in the nursery beds should approximate or actually be greater than the density and canopy cover of the existing grassland.

This will be contrasted, however, with the open bare grounds that are to be used as walk spaces and roads. The walk spaces will be 76 centimeters in width, and each bed will be separated from the adjacent bed by a walk space. There will be 30 beds in each two hectare block, and 48 total blocks in the entire nursery. The blocks will be separated by roads that are 400 centimeters in width. As a result, approximately 34 percent of the nursery will be in plant cover, with the remainder in bare soil to be used as walking paths for weeding, irrigation, agrochemical applications, transplanting, and roads for tractor operation.

Vegetative ground cover in the proposed nursery site is presently dominated by illuk grasses (Imperata cylindrica), with scattered broad-leafed trees throughout. The area in the nursery in which this cover is replaced with closely spaced pineapple plants should not result in significant changes in rainfall interception and infiltration of moisture into the soil. Evapotranspiration rates may actually decrease if pineapple planting density results in virtually complete ground cover due to the greater water efficiency of the pineapple and broader leaf surface. This could increase soil moisture, deep percolation recharging groundwater, and result in a slight increase of runoff to surface water systems. Soil loss from the planted beds should not be significant.

The areas with bare, exposed soil could have the opposite effect, however. With greater soil area exposed, evaporation

and soil loss rates could increase, while deep percolation and runoff decrease. Soil loss can expected to be high initially, and then reduced to much lower levels as the walkways become hard-packed with use. Soil loss and sediment yields from the walking paths will occur, however, particularly during the wet seasons.

The beds are to be laid out parallel to the river to discourage sediment transport and deposition, and encourage high infiltration and retention of rainwater. A network of drains are to be installed on either side of the beds and roads. These drains are to be filled with gravel and stones, which should trap much of the sediments and slow their transport. It will be important for the project to also ensure that the drains will channel also this sediment away from natural surface water systems and deposit in a manner that does not disrupt or adversely affect drainage in the adjacent riverine forests.

Runoff from the nursery should not adversely alter average daily or peak flood flows in the Dahamal Oya or Gal Oya drainages. Runoff estimates were approximated using both the Rational equation and a modified version of the U.S. Soil Conservation Service method. Assuming a 24 hour storm with a total accumulation of six inches of precipitation, the total runoff yield from the nursery should be less than 0.02 cubic meters per second (cms), or approximately 1,000 cubic meters per day. This would not represent a significant contribution to the Dahamal Oya, with average monthly flow rates of 1.03 cms, or the Gal Oya with average monthly flow rates of 1.66 cms.

Limited water quality and streamflow data prevent detailed predictions of environmental changes which might result from nursery development or operations. Streamflow data for the Dahamal Oya are based on estimates derived from assessments of the catchment area and rainfall data. Irrigation of the pineapple plants will require approximately 0.15-0.23 cms (600 liters per minute for a daily period of approximately 14 hours) diverted from the Dahamal Oya. With mean monthly flows ranging from 1.1-1.9 cms in May-October, and 2.1-16.1 cms from November-April, the irrigation diversions should only result in significant reductions in instream flows during the driest months.

However, since this irrigation diversion will be a constant requirement, there may be brief periods, on the order of several days to several weeks, when the irrigation diversions could deplete most or all of the Dahamal Oya flow. This, in turn will result in brief periods of reduced flows in the Gal Oya at the confluence point and for a short downstream reach. However, the Gal Oya continues to receive runoff from the catchment area downstream of the confluence, and total water yield in the Senanayake Samudra reservoir and wildlife sanctuary should not be significantly altered.

The Dahamal Oya does, however, serve as a water supply source for some downstream residents. It may be necessary to conduct routine monitoring of water flow conditions in the Dahamal Oya, particularly during low flow periods. If diversions for nursery irrigation requirements exceed 50 percent of the total river flow for more than five consecutive days, then the nursery should investigate plans for identifying alternative water supplies.

The nursery should not adversely affect surface or groundwater quality adjacent to, or in the vicinity of the proposed site, assuming careful control of drainage, waste products, and agrochemical use. Water quality will need to be monitored, however, to ensure that drainage, waste management, and agrochemical use are being carried out properly. It is very likely that office and housing facilities will be constructed, either officially or unofficially, in the vicinity of the proposed nursery. These structures will result in the accumulation of solid and liquid wastes, and it will be the responsibility of the nursery to ensure that these wastes are disposed of properly.

In addition, during the driest months, irrigation diversions could reduce the dilution effect in the Dahamal Oya for a short reach to the Gal Oya confluence, and periodic water quality monitoring should be done to determine if the impacts on sedimentation or eutrophication, in particular, are significant. Nursery operations could have an impact on the yield or quality of wells adjacent to the site, if stream diversions are of sufficient volume to reduce recharge to the alluvial aquifer and result in significant drawdown. Again, it will be necessary to monitor adjacent wells to determine if this effect occurs.

Road improvements from the village of Kotabawa across the Dahamal Oya and to the nursery site could result in an initial high yield of sediments from road runoff and drainage. Increased sediment loads will need to be controlled through the design and construction of road drains that collect and divert sediments away from the Dahamal Oya.

3.1.1.2 Floodplain Ecosystems and Fisheries

The proposed nursery sits in an active floodplain, and estimated flood flows with a 10 year or greater return period would very likely enter the site. These flood flows should not result in any damage to the natural environment, assuming that the riverine forests adjacent to the Dahamal Oya remains intact. However, they could be damaging to the nursery operation, and measures may want to be taken to mitigate this issue before problems emerge.

GSL law indicates that all streams with a width of 15 meters or greater require a protected riverine forest of three chains (approximately 60 meters) on both sides of the river bank. Streams with a width of from 4.5-15 meters require a

protected forest of two chains (40 meters), and those less than 4.5 meters must protect one chain (20 meters) of riverine forest. The estimated width of the wetted perimeter of the Dahamal Oya adjacent to the proposed nursery site is greater than 15 meters. As a result, it will be necessary for the nursery activity to ensure that a minimum of three chains of riverine forest are intact and protected along the east border of the nursery. A small tributary to the Dahamal Oya flowing through the northern one-quarter of the nursery site is estimated to be approximately four meters in width, and should thus protect one chain of riverine forest on both banks. These protection measures may require some re-design of presently defined nursery boundaries.

3.1.1.3 Biodiversity and Endangered Species

In general, the proposed pineapple nursery will not severely impact biological diversity in the area, and should not represent any threats to USFWS or GSL listed threatened or endangered species. There will be some loss of habitat through land clearing and cultivation. However, the lands in the nursery site do not represent essential habitat for wildlife in the area, and should not result in any decline in population levels or diversity. Lands adjacent to the proposed nursery do represent important wildlife habitat, and harvest of forest products, hunting, or other disruptions resulting from development of the nursery could adversely affect wildlife in these areas. Management guidelines for nursery staff should discourage them from altering habitat conditions in these adjacent forested areas.

Given the lack of available data, there is some uncertainty about the nature or degree of impacts which might result to rare or TES plant species in the area. It may be necessary to conduct rapid random inventories in the site to confirm the presence of any rare or TES plants, and establish appropriate conservation measures. This will be particularly important in the riverine forests adjacent to the proposed nursery site.

Conflicts between wildlife and nursery workers will likely occur. Principal confrontations can be anticipated with elephants, wild boar, deer, mongoose, primates, squirrels, rats, reptiles, and some bird species. Construction of a electric fence to enclose the nursery may discourage some, but not all of these species. Dispersal or discouragement of TES species, in particular, must also be done in a non-lethal manner. It will be necessary to identify and implement measures that can reduce wildlife/nursery conflicts in a manner that does the least amount of damage to wildlife populations.

Drainage measures in and around the nursery can have both beneficial and adverse impacts on biological diversity. At present, inadequate drainage facilities can contribute to sediment deposition and eutrophication in adjacent streams, which, in turn, depletes dissolved oxygen levels and limits

the populations of aquatic species. As was mentioned in Chapter Two, aquatic organisms, particularly macro-invertebrates, represent a critically important food source supporting elaborate food chains in terrestrial ecosystems. ACDI pineapple nursery activities that propose to improve drainage patterns should improve habitat conditions for beneficial aquatic life.

However, care must be used in implementing improved drainage to ensure that they will not eliminate remaining wetland areas in the form of springs, villus, or riverine forests. Any loss of wetlands or streamside vegetation would result in adverse impacts to biological diversity through loss of valuable habitat.

3.1.1.3 Forests

Development of the proposed pineapple nursery will result in some loss of tree cover in the area through land clearing and cultivation operations. However, the proposed nursery site does not represent intact secondary or primary tropical dry forest, with the exception of the riverine forest adjacent to the proposed site, and very small areas of remaining trees. Assuming that adequate protection is provided for the riverine forests, in particular, then clearing this specific patch of land will not result in any loss of tropical forest cover.

Further, field observations and local interviews indicate that few of the tree species in the proposed nursery site represent important species for timber or non-timber forest products. The useful species that are present in the proposed nursery site can be found in other locations in the immediate area.

Nursery workers may choose to harvest timber, firewood, and other products from the adjacent secondary forests, and these actions could result in some deforestation. In addition, there is some probability that removal of these lands from traditional chena cultivation will encourage local farmers and illegal timber cutters to move on to new lands, and expand the forest destruction. This is likely to occur even if some of these farmers find employment in the nursery operations. The limited access into this area, however, could constrain the extent of forest clearing that will occur. Nevertheless, it will be important to encouraging the GSL to consolidate and strengthen its enforcement of protected areas adjacent to the nursery site, including the Nilgala Wildlife Corridor and Gal Oya National Park.

3.1.2 Impacts to Agricultural Resources

3.1.2.1 Crops and Livestock

The environmental consequences of the proposed pineapple nursery on agricultural production in the area

should be beneficial. The nursery will encourage local crop diversification, and provide an impetus for pineapple production. The nursery can also serve as a model of appropriate soil and water conservation, and safe agrochemical use practices for local farmers.

While some local chena farmers will be relocated as a result of this nursery operation, these farmers do not at present have legal title to this property. They have not indicated any disagreement with the proposed nursery development, and may simply relocate their seasonal chena fields to adjacent grassland areas.

3.1.2.2 Agrochemical Uses

Eradication of illuk grasses will be done using Gliphosphate (Roundup). Diuron or Karmex will be sprayed on the nursery beds as a pre-emergent. If used properly according to instructions and with safe handling, storage and disposal practices, these chemicals should not result in significant adverse environmental impacts.

In the nursery stage the pineapple suckers are to be dipped in solutions of Benlate, Ridomil, Bazudine, and Surfactant fungicides before planting. All of the planting materials will be treated with a mixture of these chemicals by dipping them in the solution for two minutes. Treatment will occur within 24 hours after harvest. The plant material will be allowed to drain excess chemical back into the treating barrel or tank. The treated plant materials will be left to dry in the shade. Once dry, the planting material can be stored up to six months before planting for fruit production or to produce additional plant material. The dipping mixture will include:

Chemical	Per 175,000 Plants
Benlate	8,100 grams
Bazudine	5,400 milliliters
Ridomil	10,800 grams
Surfactant	5,400 milliliters

Again, if used properly according to instructions and with safe handling, storage and disposal practices, these chemicals should not result in significant adverse environmental impacts.

Pineapple can be subject to a range of additional pest problems, although many of these can be treated with non-chemical measures (PCARRD, 1986):

Disease	Control Measure
Fungals	
Basal rot Damping-off Heart rot Butt rot White leaf spot Pineapple wilt	Avoid contaminating the "heart" with soil infected with *Phytophthora parasitica* or *P. cinnamomi*. Use well drained soils. Plant on raised beds.
Leaf-base rot Leaf spot Root rot Soft rot of fruit	Treat fruits within two hours of harvest. Dip fruit in 1-2% o-phenyl phenate, or half of fruit in 1% sodium salicylanilide solution. Dust cut surface with 25% benzoic acid.
Nematodes	
Root-knot	Avoid frequent replanting in same field.

No insecticides are to be sprayed on the plants or beds. As the basil fertilizer will be incorporated into the soil at the time of bed preparation, there should be no agrochemical runoff which might accumulate in adjacent surface water.

Fertilizers

Fertilizers are to applied using a typical paddy mix. An initial basal mixture will be applied, followed by foliar sprays during normal plant productivity periods. Depending upon plant tissue analyses, additional side dressings may also be applied.

Fertilizer use can contribute to algae blooms in drainage canals, as well as eutrophication in streams and downstream reservoirs. This eutrophication could contribute to blocked drainage canals, and result in some loss of habitat for fish.

3.1.2.3 Pesticides Restricted or Banned in Sri Lanka

Restricted or banned chemicals in Sri Lanka have primarily emphasized chlorinated (organochlorine) pesticides. These pesticides are very persistent, often remaining in the environment for years before they break down into harmless components. Organophosphorous pesticides degrade very rapidly, although they are still very toxic.

Pesticides banned or highly restricted on the basis of health or environmental hazards by the GSL Department of Agriculture include:

Banned	Highly Restricted
2,4,5-r	Arsenic compounds
BHC mixed isomers	Aldrin
Captafol	Gamma B.HC
Chlorodimeform	Chlorodane
DBCP	Dieldrin
DDT	Organomercurials
1-3 Diachloropropene	
E.D.B.	
Endrin	
Heptachlor	
Loptophos	
Farathion	
Quintosene	
Thallium Sulphate	

The following insecticides have been restricted by the EPA, but are still on the GSL approved list.

Insectide	Formulation
Aldicarb	All granular formations; as sole active ingredient and in combination with other actives.
Aluminium Phosphide	As sole ingredient (no mixture registered)
Cyfluthrin	EC 25 percent
Carbofuran	All formulations
Isofenphos	65 percent liquid
Lindane	All formulations
Magnesium Phosphide-	All formulations Liquid formulation 40 percent and greater;
Methamidophos	Dust formulations 2.5 percent and greater.
Methomyl	As sole ingredient in 1-2.5 percent baits (except 1 percent fly bait); all concentrated solution formulations, and 90 percent wettable powder formulations (not in water soluble bags)
Monocrotophos	Liquid formulations 19 percent and greater
Oxydemeton-Methyl	All formulations
Permethrin-Methyl	All formulations
Profenofos	Emulsifiable Concentrates 59.4 percent; EPA Registration No.: 100-549 and 100-669.

Highly restricted chemicals are used with special permission from the Department of Agriculture, and are mostly restricted to a particular crop or geographical area. None of these chemicals are presently planned for use in the proposed pineapple nursery.

3.1.2.4 Problems with Chemicals Misuse

Pest Resistance

One of the more significant problems that can result from inappropriate chemical use is pest resistance. Pest resistance to a specific chemical is the ability of pest populations to survive doses of the pesticide that are normally lethal. Resistance is most likely to occur when the farmer relies only on pesticides, and applies the same ones (or ones in the same chemical group) repeatedly in increasing amounts.

Due to the high costs of pesticides, some farmers will initially underdose, and thus obtain poor control. In an effort to improve pest control, larger doses are then used in future applications. With each new pest generation more survivors are found, and a tolerance level to the pesticide is reached within the species. Tolerance proceeds rapidly to resistance.

Eventually, the resistant pests are able to survive very high (and very expensive) rates of the pesticide. As a result, the farmer may find that pest control is unattainable due to excessive costs or limited effectiveness of the chemical in question. Poor or inappropriate information supplies on chemical selection and application methods can exacerbate this problem.

The onset of resistance is also hastened when pesticides belong to the same chemical group, such as organophosphates or triazines. Pests can also become "cross resistant", or resistant to pesticides of different chemical groups.

Pest resistance is evident throughout Sri Lanka, including the Bibile-Medagama area. The pineapple nursery project will need to monitor plant production and agrochemical application rates to ensure that resistance does not occur.

Other Problems

Persistent chemicals remain unchanged in the environment for periods long enough to threaten human or other life. Persistent chemicals with a high toxicity rating can result in blood diseases, cancers, reproductive failure, or other health related problems when accumulated in living tissue in sufficient quantities. Most of these chemicals belong to the organochlorine family, included DDT, BHC, Heptachor Endrin, Eldrin, and Dieldrin. While all have been banned by both the EPA and GSL, some stocks can still be found in Sri Lanka and occasional use still occurs. None of these chemicals are proposed for use in the ACDI pineapple nursery.

Pesticide sprays are rarely specific to a particular insect, and usually result in elimination of many beneficial

insects or predators of pests. They may also result in harm to other field crops.

3.1.3 Impacts to Socio-Economic Resources

3.1.3.1 Population Dynamics

The proposed pineapple nursery and subsequent development of commercial pineapple production could result in a significant population influx to the Bibile-Medagama area. This population growth could stress existing social services and infrastructure.

However, at the same time, these economic developments could equally result in the creation of employment opportunities, which could prevent some outmigration of population from the area. The Bibile-Medagama area produces a high ratio of graduating secondary students who presently do not have significant economic alternatives besides traditional agriculture or outmigration in search of employment. Agricultural diversification through development of a pineapple nursery could increase the number of alternatives available for these individuals, and reduce the needs for outmigration.

3.1.3.2 Transportation Networks

Upgrading of the access road through the community of Kotabowa to the proposed nursery site, and then development of a road network within the nursery, itself, will result in potential problems from surface runoff and sedimentation unless adequate drainage is provided. Drainage facilities will need to be designed to withstand a minimum of a 25 year storm event, and to channel all road runoff to locations where sediment and other materials do not accumulate and contaminate surface water systems.

Operation of heavy equipment on a continuous basis along this unsealed road surface will result in significantly increased dust dispersal during dry period conditions for local residents. This dust will coat adjacent homestead gardens, and represent a health nuisance for some people. It may be necessary to monitor the severity of dust problems, and, if significant, to provide a gravel surface over road lengths that are particularly problematic.

Similarly, constant crossing of the Dahamal Oya with heavy equipment could disrupt normal flow patterns in the river and result in some localized channel instability. It may be necessary to monitor any changes in channel bank characteristics which appear to be the result of increased road traffic, and, if appropriate, to use mechanical measures to increase bank stability in the vicinity of the proposed nursery.

Road maintenance and improvement work will require collecting and moving large quantities of earth. While there are policies in place to regulate the selection and operation of these borrow pits, there may be a need to improve monitoring of earthworks. Road construction and maintenance work will likely be contracted by ACDI. As a result, supervision of contractor operations to ensure that borrow bits do not result in damage to agricultural fields, wetlands, or forested lands is essential.

Upgrading of the access road across the Dahamal Oya may encourage increased entry into these less developed lands for illegal timber harvests or other illicit uses. However, since the road upgrade will not extend beyond the Dahamal Oya, and all of the valuable timber and other non-timber forest products are located several kilometers distant from this point, then the severity of these impact should be very minimal.

Alternatively, local residents in the community of Kotabowa should benefit from road improvements through improvements in the ability to obtain supplies and transport produce.

3.1.3.3 Principal Economic Activities

The proposed pineapple nursery will not represent any disruption or alteration of traditional economic activities in the area. On the contrary, the nursery will result in the creation of approximately 200 laborer positions, and thus should improve economic conditions, at least in the immediate vicinity of the site.

Developing a pineapple industry in the region could result in the diversification and eventual development of a major source of agricultural revenues for local residents, the private sector, and the GSL. This could produce the positive benefits of increased employment opportunities and income levels for some people, stimulation of associated service industries to support pineapple operations, and diversification of economic conditions. It could also result in some increased stresses for social services and infrastructure, population inmigration, and very localized economic disparity. At a minimum, industrial pineapple development will create a need for more comprehensive economic planning and decision-making that will guide these consequences towards more positive ends. If local people are to benefit from the presence of a pineapple industry, then they will require guidance in planning their own economic participation and benefits from the beginning.

3.1.3.3 Health and Nutrition

The proposed ACDI pineapple nursery should proved beneficial for area health conditions by improving drainage in the area and reducing habitat for mosquito vectors, and

providing an opportunity to demonstrate safe agrochemical use practices.

3.1.3.5 Cultural Resources

The proposed ACDI pineapple nursery will not interact with or affect any significant archeological resources. There have been no major archeological resources identified in the nursery site, and development of this area would not appear to represent any cultural threat.

3.2 Environmental Consequences of No Action

If the ACDI Pineapple Nursery activity was not approved, then ACDI technical assistance in the Bibile area would likely end in the immediate future. It is projected that no further action through ACDI in this area would result in largely benign environmental impacts, although there would be an important loss of potential economic opportunities for local people. It is also likely that the lands proposed for the pineapple nursery would continue to be used for chena cultivation, which represents continuing problems for soil and water management, and conservation of biological diversity.

3.2.1 Impacts to Biophysical Resources

3.2.1.1 Water Resources

Under a No Action scenario, it is likely the land area proposed for the ACDI pineapple nursery will continue to be used for periodic chena cultivation, and otherwise abandoned. Recurrent fires from persistent chena cultivation could decrease soil productivity through volatization or transport of some nutrients. The water holding capacity of the soil could also be reduced through loss of organic matter and reduced microbial activity. This, in turn, could result in increased runoff to streams.

Chena cultivation is principally practiced during the onset of the rainy season, when lands cleared by fire are most susceptible to erosion and sediment transport due to high intensity rainfall. No drainage infrastructure will be in place in these chena fields to protect riverine forests and the Dahamal Oya from increased instream sedimentation. The volume of water and sediment that eventually reaches the Dahamal Oya as a consequence of chena cultivation in the 120 hectare site may not be highly significant in terms of the overall river water and sediment balance. However, the inputs will be unmanaged, and high intensity storms could result in sufficient sediment loading to influence channel stability immediately downstream from the 120 hectare site, and may adversely affect aquatic organisms in the stream.

A No Action scenario should not result in any significant impacts to water supplies in the area. Chena cultivation does not require any water diversions from surface or groundwater

sources, and continued chena cultivation should not result in any change in water quantity in the Dahamal Oya or its adjacent tributaries.

3.2.1.2 Floodplain Ecosystems and Fisheries

A No Action scenario should not represent any significant threats to natural wetlands, riverine forests, or other resources in the floodplain ecosystems, although some adverse impacts may be experienced on a small scale. Local farmers already demonstrate concern for protection of springs and wetlands, and, by and large, the chena cultivation appears to be mostly practiced away from the sensitive floodplain areas. However, chena cultivation practices do occasionally extend into these natural areas. Some disturbance does occur in wetlands and adjacent to springs. As a result, water quality conditions may be affected, although the degree of these effects should continue to be slight.

Some of the riverine forests have been cleared, principally along the tributary to the Dahamal Oya which flows through the northern quarter of the 120 hectare site. It is possible that further loss of riverine forest cover could occur under a No Action scenario, and there are no measures in place that would ensure protection of this ecosystem.

3.2.1.3 Biodiversity and Endangered Species

Under a No Actio scenario the primary land use in the proposed nursery site will likely continue to be periodic chena cultivation. Chena cultivation encourages simplification of the ecosystem unless the land area is allowed to undergo a lengthy fallow period of perhaps 12-15 years. Repeated chena cultivation in shorter time spans eventually reduces the microbial populations in the soil, results in volatization or transport of important soil nutrients, and promotes the establishment of fire-resistent invader plants. Eventually these ecological changes weaken the support system for all other biological diversity.

Habitat conditions in the 120 hectare site are already degraded, and are not conducive to any significant wildlife activity. Some species can make use of the site during periods when the grass shoots are in an early growth stage, but overall cover, nesting, and food supplies would only support occasional migration through the site by some animals.

Wildlife/farmer conflicts will continue to occur, although on a very small scale since their are so few people farming in this area. Chena farmers do not represent much of a threat to wildlife in any regards. The usual responses made by most farmers to wildlife/farmer confrontations are the application of non-lethal techniques to discourage the animals from the site.

3.2.1.3 Forests

In the proposed nursery site there is some productive use being made of remnant trees and grasses for non-timber forest products. Local farmers will protect those species from which they obtain subsistence or commercial products, but are unlikely to provide protection for other species. Extensive high-grading of all useful commercial timber species has already occurred on the site, and no valuable timber is evident. Under a No Action scenario it is likely that these lands will remain in a degraded condition as ruinate forests.

3.2.2 Impacts to Agricultural Resources

3.2.2.1 Crops and Livestock

Under a No Action scenario the agricultural uses of these lands will likely continue to be seasonal chena cultivation and livestock grazing. Within the chena fields there will probably be a continued reliance on paddy as the primary commercial crop, with some diversification into other crops as weather and market conditions permit. This chena cultivation will not represent the most productive use of these lands, and will provide few, if any, opportunities to improve or restore the agricultural ecology of the area. Agrochemicals are not widely used by local chena farmers, and no significant impacts from agrochemical usage would be anticipated under a No Action scenario.

3.2.3 Impacts to Socio-Economic Resources

3.2.3.1 Population Dynamics

Population growth, and demands for employment and services can be expected to grow under a No Action alternative, but without any apparent immediate large-scale opportunities to address these concerns. As a result, some outmigration of the local population may occur, particularly among younger residents, as people look elsewhere for more lucrative work opportunities.

3.2.3.2 Transportation Networks

Transportation services and farm access will remain largely unchanged by a No Action alternative. Access to this area is very poor at the present time, and farmers must carry in production materials, and carry out produce. Under a No Action scenario, access to the proposed nursery site will continue to be poor.

3.2.3.3 Principal Economic Activities

A No Action scenario would eliminate the opportunity for some new economic development alternatives in the region. Diversification of commercial crop cultivation and marketing would be limited to existing GSL and private sector schemes,

which are of a very small nature at present. This may result in reduced farm incomes, and limited available resources to farm organizations responsible for maintaining existing infrastructure. Beyond this, there should be little impact, either beneficial or adverse, to local economic conditions from a No Action alternative.

3.2.3.4 Health and Nutrition

A No Action alternative will not result in any significant affects to local health or nutrition conditions. Without the ACDI pineapple nursery activities, it is likely that improved drainage conditions in the chena cultivated areas will not occur. This could allow vector habitat, principally for mosquitoes, to remain intact, and constrain efforts to control mosquito-borne diseases.

3.2.3.5 Cultural Resources

A No Action alternative should not represent any significant affects, either positive or negative, to local cultural resources.

3.3 Recommended Alternative

Funding the proposed ACDI Pineapple Nursery Activity will primarily result in greater potential economic benefits for local people than taking no further action in this area. While the environmental consequences of the proposed activity do appear to be more significant than a No Action scenario, these environmental concerns can be easily mitigated. Several measures can be implemented under the proposed activity to ensure that the planned drainage, construction, and agricultural developments are all done in an environmentally sound manner. These measures are described in Chapter Four. It is recommended that the ACDI nursery activity be approved with the mitigative measures described in Chapter Four incorporated into the final design. However, it is also recommended that the activity proponent (ACDI) take responsibility for monitoring any environmental impacts, and conduct independent environmental reviews at the completion of each phase of the nursery development to ensure that the benefits of this activity continue to outweigh any possible environmental concerns.

One of the potential outcomes from the proposed nursery could be the development of a large commercial nucleus pineapple plantation on lands immediately adjacent to the nursery. It is essential that detailed and comprehensive environmental analyses be conducted to identify probably environmental consequences, alternative strategies, and mitigative measures that should accompany such a development before allowing the nursery to provide planting material or other support to the development.

4.0 Measures to Mitigate or Manage Environmental Consequences

The following mitigation measures will enable USAID and the ACDI staff to offset, minimize, or avoid any possible adverse environmental effects from the proposed pineapple nursery activity. The measures presented are intended to ensure that land clearing, drainage and irrigation infrastructure, and agrochemical applications are carried out in a manner that respects existing wetlands, sustains aquatic systems for human and animal uses, and does not disrupt natural forests or wildlife habitats. The measures also encourage safe agrochemical uses, and include recommendations for site restoration after completion of the project.

4.1 Immediate Mitigation Measures Required for Recommended Strategy

4.1.1 Inventory and Protect Wetlands

ACDI should inventory and protect wetlands and springs found within the borders of the proposed nursery site. Wetlands include distinct units of uncultivated land that are completely saturated for a period ranging from a minimum of seven days to several months each year, and in which natural plant composition is indicative of these saturated soils. Springs include natural seasonal or perennial groundwater flows occurring at the ground surface. The inventory should result in (a) a map indicating the exact locations and area of all springs and wetland areas; (b) estimated seasonal flow rates or water depth; and (c) a description of proposed protection measures. It may be necessary to contract the short-term services of a water resource specialist to conduct the required field work, and prepare the map and protection strategies. This specialist should have experience or training in hydrology or aquatic ecology, and familiarity with the analysis and conservation of wetland systems. A local consultant with university training in these disciplines could fulfill this task. Contracting of a wetlands and riparian area specialist should require a maximum of 0.5 month effort.

4.1.2 Plant Species Study

ACDI should contract the services of a trained botanist to conduct random samples within the proposed nursery site to determine the presence of any rare, unique, threatened, endangered, or sensitive plant species. This specialist should establish a minimum of four random plots approximately 0.1 acre in area, and record all plant species within each plot. At least two of these plots should include areas of reasonably intact tree cover in the riverine forest and within the proposed site. If any rare, unique, or TES species are identified in the site, then appropriate measures should be taken to conserve or transplant these species. The services of this locally contracted specialist will be required for a period of 0.5 month.

4.1.3 Drainage and Flood Control Measures

Any road drainage and flood control measures constructed as part of the proposed nursery developed should be designed to withstand or facilitate the flows from a minimum of a 25 year storm event. Road drainage and flood control measures should also be designed to minimize or avoid the input of sediments to the Dahamal Oya or nearby wetlands and springs.

4.1.4 Monitoring Borrow Pits

Road rehabilitation and maintenance activities may require the collection of soil and other materials from nearby borrow pits. These borrow pits for roadworks should be monitored by ACDI staff or other contracted services to ensure that no significant loss of agricultural or forest lands or soil erosion results from the activities.

4.1.5 Map and Protect Riverine Forest

ACDI should map and designate on the ground a protected streamside forest area that extends a minimum of three chains (approximately 60 meters) from the east bank of the Dahamal Oya. This protected riverine forest should extend the entire length of the western border of the proposed nursery. ACDI should also map and designate on the ground a protected area for the streamside forest on both banks of the tributary drainage flowing through the northern one-quarter of the proposed nursery site. This protected area should extend a minimum of one chain (approximately 20 meters) from both banks. Protection measures should ensure that all nursery development, operation and maintenance activities will not degrade or impair the ecological functions of these riverine forest communities.

4.1.6 Disperse TES Wildlife

ACDI should establish and employ non-lethal methods to discourage and disperse any TES wildlife species attempting to enter the proposed nursery site. Other species can be discouraged through conventional means. Construction of an electric fence which completely encloses the nursery site has been proposed as a tentative wildlife control measure, particularly elephants. If this or other measures prove to be inappropriate or ineffective, then the project should contract the services of a Wildlife Management specialist with particular experience in the mitigation of elephant/farmer conflicts. This specialist should be contracted to interview nursery staff and local farmers; develop non-harmful strategies for reducing or eliminating elephant/farmer conflicts; present seminars or informal dialogues with nursery staff to describe these strategies; and instruct nursery staff on suitable means for implementing these strategies. Contracting of a Wildlife Management specialist should require a maximum of 15 days work effort. A local specialist with

training or experience in wildlife sciences, and mitigation of farmer/wildlife conflicts could fulfill this task.

4.1.7 Agro-chemical Use

The proposed nursery will use agrochemicals which have been approved for General Use by the U.S. Environmental Protection Agency (EPA) and the Government of Sri Lanka (GSL), unless otherwise authorized. The USAID project manager will maintain a current annual listing of EPA and GSL restricted use agrochemicals for pineapples/[3], and will be responsible for ensuring that no restricted use agrochemicals are applied by project staff unless authorized. Agrochemicals are to be used only by applicators who have received instruction in proper handling and disposal practices. Guidelines for EPA agrochemical registration are described in Appendix C.

4.1.8 Water Quality Monitoring

Semi-annual water quality monitoring should be conducted at a point in the Dahamal Oya immediately upstream and immediately downstream from the proposed nursery site to establish baseline conditions and to detect the presence of any toxic substances which may be entering the Dahamal Oya through nursery drainage water. It will be acceptable for this water quality monitoring to measure "indicator" parameters as a means of determining the possible presence of high concentrations of sediment, chemicals, or bacteriological contaminants in drainage water. However, if these indicator parameters suggest that sedimentation or chemical pollution problems are evident, then subsequent laboratory analyses for specific chemical substances should be performed. The presence of specific chemical substances may require the abandonment of certain agrochemical substances. The presence of sediments may require improved soil and water management, and drainage techniques. The presence of bacterial contaminants may require improved waste management practices. The USAID Environment Officer will review the results from water quality data and make a determination of changes which may be required, if results indicate significant problems in any of these areas. An outline of possible indicator parameters which can be applied in this water quality monitoring is included in Appendix D.

4.1.9 Water Quantity Monitoring

ACDI staff should monitor the quantity of water (flow rates) in the Dahamal Oya during any severe low flow conditions. Monitoring can be done through visual observations or estimates using empirical hydrologic

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[3] No edible food productes will be harvested in the proposed nursery. As a result, it may be possible to use some chemicals which are normally restricted due to hazards from human consumption of harvested foods.

equations. If the amount of water being diverted for irrigation of the nursery is estimated to be greater than 50 percent of the total flows in the Dahamal Oya for a period of greater than five consecutive days, then the nursery should take the necessary steps to identify and implement a supplemental water supply source.

4.1.10 Traditional Uses of Forest

The ACDI staff should ensure that the nursery development, operations and maintenance will avoid any interference with traditional uses of the surrounding forest lands outside of the nursery area. If any conflicts over traditional land uses arise, then the ACDI project manager should negotiate mutually acceptable terms that will facilitate both nursery operations and traditional uses.

4.1.11 Environmental Review of Later Phases

ACDI proposes to implement the nursery project in several stages. It is probable that approximately 20 hectares of pineapple planting material will be cultivated as a first phase, followed by cultivation of approximately 60 additional hectares as a second phase, and then an additional 40 hectares as a third phase. The measures described in this present EA should be satisfactory to allow implementation of the first phase of the nursery project. However, ACDI should conduct a simple and concise review of possible environmental impacts which may result from the implementation of the second and third phases of this project, prior to completing any additional field work. These simple environmental reviews should be conducted by an independent, objective individual or group with experience or training in environmental science or impact analysis. These subsequent analyses can follow a standardized format that uses professional qualitative judgements and interpretation of existing data. An illustrative example of an environmental review form which could be used to complete these analyses is included in Appendix D. It is estimated that completion of each review should require a maximum of ten days work effort. A local specialist with experience or university training in the environmental sciences, geography, or biological sciences could be contracted to fulfill this task. If necessary, technical support can be provided to this individual through the USAID-funded Natural Resources and Environmental Policy Project (NAREPP).

4.1.12 Site Restoration Plan

ACDI should prepare a site restoration plan to ensure the natural recovery of the land if the nursery is discontinued at any future time. As a first task, the natural drainage patterns, and typical secondary forest vegetation in the area should be documented prior to nursery construction to guide future restoration efforts. The restoration plan should include a description of measures that would be employed to

(a) remove all pineapple plant materials, (b) rip and restore all roadways within the nursery area, (c) contour the land to facilitate natural drainage, and to minimize sedimentation of waterways, (d) select and plant native leguminous tree species that will act as an effective nursery crop to encourage natural forest recovery, and (e) establish native grasslands that have been identified as preferred wildlife fodder. Nursery fencing, if in place, should be left intact until the planted grasses and trees have attained a growth maturity that will enable them to withstand wildlife browse. Responsibility for subsequent fence removal should be entrusted to an appropriate GSL agency.

4.2 Implementation Schedules for Recommended Measures

Depending upon the extent of outside technical assistance (TA) sought to implement the mitigative measures, the TA required to ensure the environmental soundness of the proposed ACDI Pineapple Nursery Project will not be excessive. Anticipated TA would include the following:

Specialist	Duration	Schedule
Wetlands Specialist	0.5 month period	Immediate
Botanist	0.5 month period	Immediate
Wildlife Specialist	0.5 month period	Depending upon incidents of wildlife conflicts
Environmental Impact Specialist	0.5 month period	Prior to implementation of each nursery phase

Other costs for the mitigative measures may require some minor, if any, increases in the current implementation budgets. It may be necessary to shift some resources from other activities to accommodate these changes. These modifications should be completed by the ACDI nursery project manager in consultation with staff, and based on final determination of the nature of modifications which may be required.

4.3 Monitoring of Mitigative Measures

It will be the responsibility of the USAID Project Officer for the ACDI Pineapple Nursery activity to conduct periodic monitoring to ensure compliance with the mitigative measures. The Project Officer should work in association with the ACDI Project Manager to establish a time schedule for completing each of the mitigative measures, and to document the environmental status of the project in quarterly reports. Quarterly documentation of this environmental monitoring should be made available to the USAID Environmental Officer, and other interested parties who submit formal requests for the information.

4.4 Recommendations for Environmental Analyses of Future Development of Commercial Pineapple Production

The purpose of the proposed ACDI Pineapple Nursery Activity is to increase the available planting material for possible commercial production of smooth Cayenne pineapples. One outcome of this activity could thus be the establishment of large scale, commercial pineapple farming operations on lands adjacent to or in the vicinity of the proposed nursery. A recent analysis conducted by ACDI indicates that a commercial operation of this nature should include a minimum of 2,000 contiguous hectares of nucleus pineapple production (Smith, 1992).

Given the proximity of these lands to major wildlife sanctuaries and critical catchment areas, it is probable that such additional large-scale commercial developments could contribute to some significant adverse environmental changes. In general, these changes could include:

- loss of wildlife habitat and decline in the populations of some species, including some TES species;
- changes in runoff patterns, water and sediment balances, and microclimatic conditions;
- loss of some timber and non-timber forest products;
- expansion of chena cultivation in other undisturbed areas;
- increase in agrochemical uses in the area, and
- stresses on existing social infrastructure.

It may be possible to minimize or avoid some of these adverse impacts if careful environmental impact assessment and planning accompanies any proposed activity expansions. It is certainly essential that such an analysis be conducted prior to pursuing such large-scale land developments. This assessment and planning would require collection and interpretation of a considerable amount of data that are presently incomplete or unavailable, including information on wildlife populations and habitat conditions; water and sediment balances in the affected watersheds; and forest inventories. A description of the parameters that should be considered in the analysis of a larger scale commercial operation is included in Appendix E.

USAID fully expects that any major commercial developments which might emerge as a result of the establishment of a pineapple nursery farm, such as a large nucleus pineapple farm, processing facility, or other such land or resource intensive activities, will be subject to a detailed environmental analysis. USAID has indicated that it does not, at this time, anticipate providing any additional funding to

support developments other than the nursery farm, and expects that further environmental analyses will become the responsibility of the GSL. It is essential, however, for such detailed and comprehensive environmental analyses be conducted to identify probably environmental consequences, alternative strategies, and mitigative measures that should accompany such a development before allowing the nursery to provide planting material or other support to the development.

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A P P E N D I X A

APPENDIX A

Summary of Scoping Period Findings

1.0 Rationale for an Environmental Assessment of the Proposed ACDI Pineapple Nursery Project

USAID/Sri Lanka has proposed to finance a pineapple nursery through an arrangement with Agricultural Cooperatives Development International (ACDI). ACDI intends to develop this pineapple nursery in the Bibile/Medagama region of Uva Province for the purpose of increasing the amount of smooth Cayenne pineapple planting material available to support commercial pineapple production schemes.

ACDI has prepared a status report on the nursery farm for this proposed activity. In accordance with USAID policy, a decision has been made to conduct an Environmental Impact Assessment (EA) of the proposed activity in order to identify any potential environmental impacts, both beneficial and adverse, which may result from the implementation of this activity. The EA will also define specific measures which may need to be included to ensure that the project is environmentally sound and sustainable. Like other studies, the EA will contribute to the design process, and is intended to be used by nursery staff to facilitate and guide implementation. To ensure host country participation, local governments and NGOs will be involved during the planning process.

2.0 The Role of the Scoping Process in the Preparation of an EA

A preliminary step in the preparation of all EAs is to conduct a scoping process. The scoping process involves a series of formal and informal meetings with people who may be affected by the proposed project either directly or indirectly. This would include government officials, local farmers, merchants, or representatives from non-governmental entities. The purpose of the scoping process is to:

- provide host country institutions and affected people with an opportunity to assess the proposed project, and identify potential environmental issues and alternative strategies;

- refine the Scope of Work for the EA team, and help set realistic and measurable goals and objectives for the EA;

- identify existing sources of data, key individual contacts, and important areas of field study for the EA team;

- accelerate the pace of EA investigations, and facilitate rapid data collection and analysis; and

- ensure on-going dialogue between the EA team and host country institutions and affected people.

Formal scoping sessions bring together a wide spectrum of specialists with extensive knowledge or experience to help the EA team identify all issues which must be addressed in the assessment process. These specialists can also help define the level of detail which should be given to each issue. Scoping session participants will also identify possible alternatives to the proposed program activities.

Informal scoping activities include random interviews and review of existing data. Many of these informal interviews are performed in the field with people who will be directly or indirectly affected by the proposed project. They may also include discussions with government and private sector personnel, other donors, and individuals with particular expertise relevant to the proposed project.

In the process of defining the key environmental issues and overall content of the EA, all participants will become familiar with the environmental policies within which USAID must operate. This information will enable participants to recognize the role of the EA in the final design and implementation of the proposed project.

At the completion of the scoping process the significant environmental issues which should be analyzed should be evident to the EA team, and an outline of the EA document will be prepared.

3.0 Overview of USAID Environmental Policies

USAID must follow a clearly defined set of agency policies and environmental mandates. Formal environmental procedures originate from the U.S. National Environmental Policy Act (NEPA), authorized by Congress in 1969, and subsequent guidelines developed in 1976 by USAID in consultation with the U.S. Council on Environmental Quality (CEQ). In summary, this legislation resulted in a USAID policy to:

3.1 Identify Environmental Consequences of AID Activities

USAID Missions must ensure that environmental consequences of AID-financed activities are identified and considered by both USAID and the host country prior to a final decision to proceed, and that appropriate environmental safeguards are adopted within the project.

3.2 Assist Developing Countries Evaluate Environmental Issues

USAID Missions must assist developing countries to strengthen their capabilities to appreciate and effectively evaluate the potential environmental effects of proposed

development strategies and projects, and to select, implement and manage effective environmental programs.

3.3 Impact Assessments

USAID Missions must identify all impacts upon the environment resulting from AID's actions, including those aspects of the biosphere which are the common and cultural heritage of all people, and

3.4 Define Environmentally Limiting Factors

Define environmentally limiting factors that constrain development, and identify and carry out activities that assist in restoring the renewable resource base on which sustained development depends.

4.0 The Role of an EA in Project Development

USAID environmental procedures are established in U.S. federal regulations (22CFR, Part 216). They require a precise process which must be followed to ensure the environmental sustainability of USAID-supported projects. Final project authorization is dependent upon completion of these requirements. This step-by-step NEPA process is summarized in Figure A-1.

If an Initial Environmental Examination (IEE) of the Project Identification Document (PID) determines that proposed project activities may have an affect, beneficial or adverse, on environmental conditions within the project area, then an Environmental Assessment (EA) of the project is required. As defined in 22 CFR, Part 216, the EA should:

- Describe the goals, objectives, institutional structure, and experiences to date of the proposed project;
- Describe in concise, but detailed terms the present condition of the environment to be affected by the proposed project, including the physical, biological, and social environment;
- Identify and describe in concise, but detailed terms alternative strategies for achieving the goals and objectives of the project within the identified environmental conditions;
- Identify and discuss the environmental consequences of all proposed project activities for each alternative within the affected environment;
- Use appropriate measurement criteria to identify a preferred alternative that ensures environmental safeguards, and that assists host country capabilities to evaluate, select, implement, and manage environmental protection measures; and

- Identify and describe mitigative measures that will minimize or avoid altogether any possible adverse environmental impacts that could result from the project, and assist in restoring the renewable resource base within all areas directly or indirectly affected by the project.

Amendments to the U.S. Foreign Assistance Act (Sections 117, 118, and 119) further define issues which USAID must address in its environmental analysis process. Specifically, these amendments require the EA to identify and describe how project activities may affect the conservation of tropical forest and biological diversity, and ensure safe use of agrochemicals. Mitigation measures must be included in the EA to ensure that the project does not result in any loss of existing tropical forest cover or biological diversity within the project area.

5.0 Importance of EA Compliance

The EA must also identify measures to be included in project activities to ensure compliance with all measures and recommendations. The EA will identify appropriate monitoring institutions, criteria, and methods for data collection and analysis, and mechanisms for interpretation of compliance. Non-compliance with finalized environmental measures as stated in the EA could result in a stop-order being placed on the project until compliance is resumed.

6.0 Environmental Issues Identified in Formal Scoping Sessions

A formal scoping session to discuss the proposed ACDI Pineapple Nursery was held in Colombo, Sri Lanka, on March 30, 1992, with personnel from USAID, Government of Sri Lanka (GSL) officials, and representatives from non-governmental and private sector entities. This meeting was attended by 28 individuals, and included an overview of USAID environmental policies, and proposed activities.

The proposed pineapple nursery generated extensive discussions in which the following potential environmental issues and concerns were identified by the group:

- Proposed water diversions from the Dahamal Oya drainage to supply irrigation water to the nursery should be evaluated to determine if any adverse impacts will occur to local surface and groundwater supplies. Specifically, the EA should determine if the proposed diversions will adversely change flow conditions in the Gal Oya or Senanayake Samudra sanctuary downstream from the proposed nursery site.

- Water quality monitoring should be implemented to determine if agrochemical use or soil management

practices is adversely affecting downstream water supplies for humans and wildlife.

- The EA should indicate all threatened, endangered, or sensitive plant and animal species located in the proposed nursery site prior to any clearing or development of land.

- The EA should determine if the proposed clearing of forest and grassland areas will result in any loss of wildlife carrying capacity, particularly for threatened or endangered species in the area.

- The proposed nursery should include measures to discourage and prevent wildlife from entering the site. The EA should also identify measures that could help prevent the nursery from attracting wildlife that may, in turn, invade adjacent farm fields.

- The EA should indicate environmental impacts that may occur at different levels of pineapple production. Specifically, the impacts of a 50 acre, 200 acre, and 300 acre nursery should be considered.

- The EA should identify critical points of decision at which the project may elect to expand operations, and describe in detail the terms of reference for additional environmental analyses which may be required before proceeding with any expanded operations.

- The EA should determine if alternative sites are locally available and more appropriate for the proposed nursery, and indicate the suitability of the pineapple plant for agro-ecological conditions in the Bibile/Medagama area.

- The EA could result in improved social conditions in the project area through the creation of jobs, and the facilitation of commercial outgrowers of pineapple. The project could also encourage greater crop diversification in the region, which could have valuable social and ecological results.

- The EA should note that the proposed nursery activity will be supportive of, and thus linked to any large scale commercial nucleus farm activities which might subsequently be established. Assessing the proposed nursery site should thus, at a minimum, include reference to the potential consequences from the development of a more large scale nucleus farm.

These issues and concerns have been used to guide the analysis conducted by the ecologist preparing the EA, and represent an important input to the overall EA document.

7.0 Environmental Issues Identified in Informal Scoping Sessions

Informal interviews and field investigations were conducted in the Bibile and Medagama regions between March 18-24. Approximately 100 farmers, four school teachers, six local government officials, 10 shopkeepers and merchants, and one Buddhist priest were interviewed as part of this scoping process. Most people contacted had only limited knowledge of the proposed project, and much of this was based simply on local hearsay. However, local concerns and recommendations for environmental protection were strong, and the following issues represent a summary of the points raised by local people in the course of this informal scoping process:

7.1 Effect of Land Clearing

Clearing 300 acres of land to establish an intensive pineapple nursery should not have significant effects on regional climatic conditions or hydrology. The project should monitor water quality to determine if the project is affecting adjacent wells or rivers. If water is to be taken from the adjacent Dahamal Oya drainage, then the project should not disrupt the river flow patterns, or significantly alter typical flows received downstream. Local residents felt it will be essential to protect the riparian forests along the drainages in or adjacent to the proposed nursery, and to protect all the springs and wetlands in the project site. It is interesting to note that clearing an area of land larger than 300 acres was seen by nearly all local people to represent a significant threat to regional climatic or hydrologic conditions. Residents indicated a concern that a larger project could result in less soil moisture in the area, higher ground temperatures, changes in runoff patterns, and more frequent drought conditions in the future. There were concerns that groundwater levels may drop, and wells may go dry.

7.2 Threat to Wildlife

Informal meetings did not reveal any sense of threat to wildlife. Most people felt that the animals in the site will simply move to other areas. Again, local people only felt wildlife would be affected if a much larger project were put in place. Local informants did indicate, however, that several threatened and endangered species (TES) occur in the vicinity of the proposed nursery site, among them being elephants, monitor lizards, Toque macaques, the Indian python, and the red-faced Malkoha, leopard, and purple-face langur. Only the elephants and monitors are commonly seen, and all of the species are reported to be only occasional visitors and not resident in the project site.

7.3 Chena Cultivation

The proposed nursery site in presently used for seasonal slash and burn ("chena") cultivation by local farmers. Removing this land from traditional chena use will probably encourage local farmers and illegal timber cutters to move on to new lands, and expand the forest destruction.

7.4 Medicinal Plants and Wild Foods

Important medicinal plants and wild foods are collected from the proposed nursery site. The site, however, is not considered to be one of the more significant areas for collection of fuelwood, timber, or non-timber forest products.

7.5 Job Creation

The proposed nursery project is expected to have a beneficial impact on the local social environment through the creation of jobs and the facilitation of a pineapple outgrower program. However, the number of jobs to be provided by the nursery will not significantly improve local unemployment problems, and the overall social benefits will only materialize if an outgrower component is developed. An outgrower program will need to include technical assistance in commercial pineapple production and marketing for local growers, as these skills are limited in the region at present.

It will be important to provide local residents with an opportunity to describe these concerns, and especially to assist their understanding of the potential impacts of land use changes on hydrologic processes. Their interpretations of possible hydrologic changes which could result from large scale land clearing were certainly well founded, and obviously based on sharp observation of natural processes. However, they had difficulty defining the range of possible scenarios which could result from land use changes, and expressed an interest in learning more about these technical issues.

These concerns will need to be addressed if the proposed nursery does evolve into more extensive pineapple cultivation within a large contiguous land unit.

Again, these issues and concerns have been used to guide the analysis conducted by the ecologist preparing the EA, and represent an important input to the overall EA document.

A P P E N D I X B

APPENDIX B

U.S. Environmental Protection Agency Registration Policies for Agrochemicals Proposed for Use in Project Area

The US EPA Registration Status of Proposed Pesticides

It is USAID policy to attempt, whenever possible, to use only pesticides that the U.S. Environmental Protection Agency (EPA) has registered as "General Use" (GUPs). In the U.S., GUPs can be purchased and used without restriction as a result of EPA determination that these chemicals present minimal harm to persons and the environment if used according to label instructions. On the other hand, "Restricted Use Pesticides" (RUPs) can only be purchased and used in the U.S. by persons certified by law. RUPs generally are very toxic or their normal use is considered too hazardous for persons who have not received specially training in correct use. In the U.S., RUPs can only be purchased and used by certified, licensed applicators or persons directly supervised by them. RUPs are usually considered unsuitable for use in AID projects.

Pesticides are under regular review by the EPA's Office of Pesticide Programs, Registration Division, and are so indicated. As a result of Special Reviews, the status and uses of some pesticides could be canceled. It will be important for the USAID Project Officer for the ACDI pineapple nursery activity to establish an annual update on the list of GUPs and RUPs resulting from EPA Special Reviews. This information can be obtained by calling the EPA Office of Pesticide Programs in the U.S. at (703) 557-7700.

A Partial List of Pesticides Restricted in the U.S.A. and Available in Sri Lanka

aldicarb (Temik): insecticide/acaracide/nematicide
aluminum phosphide (Quick Phos): fumigant
benomyl (Benlate): fungicide
brodifacoum (Klerat): rodenticide
captafol (Difolatan): fungicide
captan (Orthocide): fungicide
carbofuran (Furadan): insecticide
carbophenothion (Trithion): insecticide/acaracide
chlordane (Orthro Klor): insecticide
cyhexatin (Plictran): acaracide
dicofol (Kelthane): acaracide
dimethoate (Perfekthion): insecticide acaracide
disulfoton (Di-Syston): insectidie/acaracide
endosulfan (Thiodan): insecticide/acaracide
fenamifos (Nemacur): nematicide
fenvalerate (Belmark): insecticide
isazophos (Miral): nematicide/insecticide
lindane (Gamma Tox): insecticide
metaldehyde (Metaldehyde): molluscicide
methamidaphos (Monitor): insecticide/acaracide
methidathion (Supracide): insecticide/acaracide

methomyl (Lannate): insecticide
mevinphos (Phosdrin): insecticide/acaracide
mirex: insecticide
monocrotophos (Azodrin): insecticide/acaracide
omethoate (Folimat) insecticide/acaracide
oxamyl (Vydate): insecticide/nematicide/acaracide
oxyfluorfen (Goal): herbicide
paraquat (Gramoxone): herbicide
PCNB (Terreclor): fungicide
phosphamidon (Dimecron): insecticide
trifluralin (Treflan): herbicide

Possible Effects of Agrochemicals on the Environment

Use of GUPs in ACDI pineapple nursery activities should cause no harmful effects to the environment if the chemical is used by properly trained applicators in accordance with the instructions on the pesticide label. Nevertheless, there may be times when pesticides will be misused unintentionally. This misuse can have significant effects on ecological conditions in the project area.

Many insecticides are very toxic to bees, and these invertebrates can serve as an important indicator of potential harmful impacts to other non-target organisms. If spraying cannot be avoided during the flowering period of desired plants, then it should be done early in the morning or late in the afternoon when temperatures are cooler and non-target organisms less active. The relative toxicities of some pesticides to bees include:

Highly Toxic: carbaryl, carbofuran, diazinon, dimethoate, fenitrothion, formothion, lindane, and malathion.

Moderately Toxic: disulfoton and methomyl

Slightly Toxic: dicofol, endosulfan, and trichlorfon.

Numerous pesticides have the potential of entering the aquaculture environment in runoff from pesticide-treated fields. Fish and shrimp are extremely susceptible to endosulfan, for example. Unfortunately, very limited data are available to quantify or even estimate the lethal levels of specific pesticide applications or residues on vertebrate or invertebrate organisms. Applied research which attempts to document the levels of pesticides being ingested by indicator species, and the apparent effects of these levels is certainly warranted, since there are few places left in Sri Lanka where wildlife can thoroughly avoid contact with agrochemicals.

Toxicity and EPA Characterizations of Selected Pesticides

All agrochemicals, including pesticides, are toxic to some degree, and therefore must be treated with caution. Even some pesticides that are of comparatively low toxicity can be extremely hazardous to users because risk of exposure is

great. Toxicity indicates how poisonous a chemical is. Hazard is a function of toxicity and degree of exposure to the chemical.

Pesticides can enter the body through ingestion, by passing through the skin, and by being inhaled. Once in the body, the pesticide passes through the bloodstream to site(s) of reaction, and poisoning or death results.

The relative toxicity of a pesticide can be judged from its acute LD50 (lethal dose) value. This is a statistical estimate of the amount of the pesticide required to kill 50 percent of the population of test animals. The LD50 is expressed in milligrams (mg) of pesticide chemical per kilogram (kg) of body weight of the animal when swallowed (oral LD50) or absorbed through the skin (dermal LD50). Rats and rabbits are generally used for these tests. The pesticide is administered once to the laboratory animal for a rapid, acute effect, hence the term acute LD50. A severe poisoning from such a single exposure causes acute toxicity. The term LC50 (lethal concentration) is sometimes used to describe toxicity from inhalation, or toxicity to fish in water, and is expressed in parts per million (ppm).

The lower the LD50 value, the more toxic the pesticide is to humans. Ingestion of only a few drops to a teaspoon (5 ml) of a pesticide with an oral LD50 value of less than 50 might be enough to kill an adult, whereas 450 ml might be required to kill the same person who ingests a pesticide with an oral LD50 of 5000 or greater. However, the pesticide's formulation, percentage active ingredient, and application method determine how hazardous it is to use. Rodenticides, for example, usually have low acute oral LD50 values, but are considered only moderately hazardous to persons because their pellet formulations are only about two percent active.

A P P E N D I X C

APPENDIX C

Water Quality Parameters and Sampling Frequency

The following list represents a variety of parameters which can be used to indicate significant changes in water quality conditions. The proposed pineapple nursery would most benefit from measuring BOD, Chloride, fecal coliform and fecal streptococcal bacteria, N-NO3, TDS, pH, temperature and turbidity on a quarterly basis. If technically feasible, annual measurements of benthic macroinvertebrates would also be valuable.

At Stream Site	In Laboratory	Typical Sampling Frequency
discharge	BOD	biweekly/bimonthly
temperature	Chloride	biweekly/bimonthly
conductivity	FC bacteria	biweekly/bimonthly
	FS bacteria	twice a year
	N-NO3	biweekly/bimonthly
	TSS or turbidity	biweekly/bimonthly
pH	TDS	supplemental
	macroinvertebrates	special studies
	herbicides	special studies
	pesticides	special studies

Parameter Descriptions

Benthic Macroinvertebrates — A biological analysis of organisms that will indicate changes in physical and chemical water quality conditions.

Biochemical Oxygen Demand (BOD) — An indicator of potential lowering of dissolved oxygen levels due to decomposition of organic wastes by microbes.

Chloride — A good indicator of sewage and animal wastes.

Conductivity — A simple estimator of TDS and an index of inorganic pollutants.

Fecal Coliform Bacteria (FC) — An indicator of contaminants caused by human or animal wastes.

Fecal Streptococcal Bacteria (FS) — FC:FS ratios may indicate whether fecal contamination is of human or animal origin.

Nitrate as nitrogen (N-NO3) — An indicator of nitrogen-containing fertilizer or pesticide contamination.

pH	A valuable measure for interpreting solubility ranges of chemical parameters.
Temperature	A requirement for pH and conductivity, and a valuable measure for interpreting solubility ranges of chemical parameters.
Total Dissolved Solids (TDS)	An index of inorganic pollutants, TDS increases with increased ion concentrations (e.g. toxic metals).
Total Suspended Solids (TSS)	An indicator of stream sediment carrying toxic metals.
Turbidity	A simple estimator of TSS.

A P P E N D I X D

APPENDIX D

Illustrative Initial Environmental Review Form for Pineapple Nursery Development Activity

The following illustrative form provides a scheme which can be used by volunteers or technicians to identify and rank probable environmental impacts from each phase of proposed field work on the pineapple nursery activity prior to the initiation of construction or development activities. The form can also be used to help identify mitigative measures that will eliminate these environmental impacts. This form can be used after approximately 50 acres of the nursery has been completed to determine if any significant impacts would occur during nursery expansions. The form can be used again when expanding from 200 to 300 acres. This form is not intended to be used to assess the impacts of any activities which may occur in an area greater than 300 acres. If any significant impacts are identified as a result of the analyses conducted using this form, then an additional Environmental Assessment following standard U.S. NEPA or Government of Sri Lanka guidelines may be warranted.

Impacts are identified as to whether they are of MINOR, MODERATE, OR SIGNIFICANT environmental concern. Any MODERATE impact should identify measures that can improve the scheme. Any SIGNIFICANT impacts should identify alternative activities which can replace the initial proposed activity.

PART I Activity CHARACTERIZATION

Activity Description

_____

_____

_____

_____

_____

1. Map the natural drainage directions, and approximate affected area within which the activity will occur. Affected area includes lands directly upstream and downstream from the proposed activity, which the activity could alter by changing runoff or flood flows, vegetation cover, or soil conditions.

2. Obtain information from locals or GSL officials on the likelihood of occurrence of important wildlife, fisheries, or habitat types, and the presence of threatened or endangered species in the affected area.

   Note: Bring the map to the field when doing the field review.

PART II FIELD EVALUATION

Based on available information and field observations, evaluate the predicted effect of the proposed activity on the following resources. Include proposed mitigation resources, if necessary.

N NO environmental impact or IMPROVED environmental conditions
L MINOR negative environmental impact
M MODERATE negative environmental impact
S SIGNIFICANT negative environmental impact
U UNKNOWN environmental impact

I. Water Resources

Use the drainage map to make a brief sketch of the proposed development scheme. Identify significant local features, including rivers, canals, ponds, lakes, forest lands, wetlands or other unique habitats, and archeological sites. Show the apparent flow directions for floods, and note any obvious signs of flood depths or flood locations for a 10 year flood. Include a map scale.

1. The activity is located in a floodplain area (Yes) (No)

2. The activity will increase/decrease/have no effect on the duration of floods (circle one answer). If yes, the ranking of impact is _____.

3. The activity will change the location of floods (Yes) (No) If yes, the ranking of impact is _____.

4. The activity will change stream channel shapes, or the amount or type of vegetation alongside streams (Yes) (No).

Impact Ranking

MINOR	MODERATE	SIGNIFICANT
Some change, but overall channel & vegetation remains the same.	Causes measurable change in shape or vegetation.	Causes major change in channel shape or vegetation.

5. Recommended measures to mitigate effects:

_____
_____
_____
_____
_____

6. Explain how recommended measures will mitigate (reduce) moderate or significant impacts:

_____
_____
_____
_____
_____

7. What moderate or significant impacts cannot be mitigated and why?

_____
_____
_____
_____
_____
_____

II. Fish and Wildlife

1. Activity will result in destruction or degradation of habitat for fish or wildlife (Yes)__(No)__.If yes, the ranking of this impact is _____.

2. Activity will block fish or wildlife migratory pathways (Yes)__(No)__. If yes, the ranking of the impact is _____.

Impact Ranking

MINOR	MODERATE	SIGNIFICANT
Impacts localized and no impacts to migratory pathways or habitat.	May temporarily block migratory pathways or eliminate habitat.	Blocks migratory pathways or will eliminate habitat.

3. Endangered or threatened species are likely to occur in the activity area (Yes)__(No)__. If yes, list.

_____
_____
_____
_____

4. Proposed activity will result in loss of individual threatened or endangered species (Yes)__(No)__. If yes, which one(s) and how?

_____
_____
_____
_____

5. Will any loss of habitat affect the survival of species? (Yes)__ (No)__. Explain.

_____
_____
_____
_____

6. Recommended measures to mitigate effects:

_____
_____
_____
_____
_____

7. Explain how recommended measures will mitigate (reduce) moderate or significant impacts.

_____
_____
_____
_____
_____

8. What moderate or significant impacts cannot be mitigated and why?

_____
_____
_____
_____
_____

III. Vegetation

1. Vegetation types found in the area include:

_____
_____
_____
_____
_____

2. Activity will result in cutting of trees, or loss of vegetative cover (Yes)__ (No)__. The ranking of the impact is _____.

Impact Ranking

MINOR	MODERATE	SIGNIFICANT
No loss of important plant communities or changes in runoff.	Some loss of important plants and change in runoff patterns.	More than 50 % of plant cover lost and runoff patterns vary greatly.

3. Recommended measures to mitigate effects:

_____
_____
_____
_____
_____
_____

4. Explain how recommended measures will mitigate (reduce) impacts.

_____
_____
_____
_____
_____

5. What moderate or significant impacts cannot be mitigated and why?

_____
_____
_____
_____
_____

IV. Soils

1. Changes in soil moisture: (a) waterlogging _____, (b) drought _____.

2. Activity will cause soil loss from farm fields? (Yes)__ (No)__ If yes, ranking is _____.

3. Activity will result in adverse changes to soil physical or chemical conditions? (Yes)__ (No)__. If yes, ranking is _____.

Impact Ranking

MINOR	MODERATE	SIGNIFICANT
Soil loss < than 5 tons/hectare/year, & no salt or chemical concentrations	Soil loss > than 5 tons/hectare/year, and some salt or chemical concentrations	Loss > than 10 tons per hectare/year and high salt or chemical conc.

4. Recommended measures to mitigate effects:

_____
_____
_____
_____
_____

5. Explain how recommended measures will mitigate (reduce) impacts.

_____
_____
_____
_____
_____

6. What moderate or significant impacts cannot be mitigated and why?

_____
_____
_____
_____
_____

V. Cultural Resources

1. Proposed activity will result in the loss of archeological, historical or cultural resources. (Yes)__ (No)__. If yes, identify resources and rank the impact.

Impact Ranking

MINOR	MODERATE	SIGNIFICANT
Activity will make cultural resource less accessible.	Activity will result in loss or damage to less important resources.	Activity will result in the loss or damage of important resources.

2. Recommended measures to mitigate effects:

3. Explain how recommended measures will mitigate (reduce) impacts.

4. What moderate or significant impacts cannot be mitigated and why?

VI. Summary of Moderate and Significant Impacts and Recommended Mitigative Measures:

A P P E N D I X E

APPENDIX E

Guidelines for Environmental Analyses of Possible Future Agricultural Developments Adjacent to the Proposed ACDI Pineapple Nursery

Concern has been raised about the possible environmental consequences which could occur from the development of a large contiguous pineapple nucleus farm on lands adjacent to the proposed ACDI pineapple nursery. This nucleus farm has been recommended as a good means to ensure that sufficient pineapple fruit would be produced to sustain a processing facility, and to induce large scale outgrower operations among area residents.

The minimum area recommended for such a nucleus farm is 2,000 hectares. The GSL has indicated to ACDI that a block of land of this size could be made available to the east of the Dahamal Oya and west of the Gal Oya National Park and Sananayake Samudra Sanctuary. Development of such a nucleus farm in this location would encompass most of the land base in between the protected areas and the Dahamal Oya to a border approximately one-half kilometer south of the proposed nursery site.

The development of such a nucleus farm would be outside of the scope of work to be done by ACDI on the pineapple nursery, and would likely be undertaken by an independent private sector firm. USAID has not indicated that any financial assistance would be provided to promote or facilitate the development of such a nucleus farm. As a result, any environmental analyses of such a development would become the responsibility of the Central Environmental Authority (CEA) within the GSL.

However, because some connection does exist between the proposed ACDI nursery and future commercial pineapple developments in this region (e.g., the nursery could motivate and facilitate such developments by providing the necessary plant materials to the developer), several requests have been made for USAID to identify, in general terms, the nature of problems which should be anticipated, and the terms of study which should be addressed in preparing for such a larger project development.

In general, the significant environmental consequences from large scale agricultural developments in this area would be experienced in terms of soil and water management, deforestation, changes in wildlife habitat conditions, and changes in the socio-economic structure of the area. The size of the proposed nucleus farm, and the proximity to a large protected area and wildlife sanctuary, will increase the magnitude of some of these impacts. In particular, the more

significant adverse consequences which could result from the development of a large nucleus farm would include:

- Elimination of wildlife habitat through land clearing operations. This could lead to a decline in the population levels of many wildlife species, including eight recognized TES species, and increased conflicts between wildlife and human populations.

- Removal of the forest cover could lead to changes in runoff patterns and microclimatic conditions. Even a densely planted pineapple farm will not provide the soil cover that is found in a mature secondary forest, especially considering the area of land in roads or walkways that will not include any vegetative cover. More rapid runoff combined with increased soil loss could be a consequence of the agricultural development. These changes could alter soil and water balances in the Gal Oya drainage and Sananayake Samudra reservoir. These hydrologic changes could also result in a loss of some wetlands, and elimination of springs. Microclimatic changes could also be anticipated in terms of significantly altered soil microbiology and evapotranspiration conditions.

- Land clearing could also contribute to a loss of some timber and non-timber forest products. These forest products provide a small, but recognized basis of revenue for some local residents, and represent an important source of genetic diversity.

- Clearing of large tracts of continuous forest and grassland areas could encourage local residents to move into other undisturbed forest areas in order to practice chena cultivation, collect firewood, timber, and non-timber forest products, and hunt, if they could find some way to access these lands. This suggests that the actual forest loss could be greater than simply the area cleared for commercial pineapple production.

- Commercial pineapple production on a larger scale could encourage more extensive use of agrochemicals for weed, fungi, and insect controls. However, it is likely that any large scale commercial agricultural operations would come equipped with the technical and financial capacity to ensure safe agrochemical use, given defined standards and operating procedures.

- Large scale commercial pineapple production could encourage significant population increases in the area as people come looking for work. This will increase demands for sanitation and waste management, and could stress existing economic and administrative infrastructure.

Some of the beneficial consequences which could result from the development of a large nucleus farm would include:

- A highly significant increase in the employment opportunities for local residents, including both skilled and unskilled jobs. The employment provided directly by the nucleus farm would likely be matched, or possibly exceeded by an increase in local service industries and commercial markets catering to employees and increased revenues in the area.

- Improved social and economic infrastructure in the area, as new schools, health facilities, water and waste disposal systems, and other public services accompany population and economic growth.

- Improved agricultural extension programs to guide outgrowers in commercial pineapple production, and safe use of agrochemicals and other measures for pest control.

As always, these potential long term economic benefits must be weighed against long term environmental costs in order to determine if the project is socially, economically, or ecologically sustainable. A first step in evaluating these concerns will be an analysis of potential environmental impacts from the development, and determination of measures which can be carried out to mitigate or avoid any significant environmental degradation in the area. The preparation of such an analysis will require the collection of some data which do not now exist, and some qualitative interpretations based on limited information. At a minimum, such an environmental analysis of any proposed large scale commercial development of lands adjacent to or in the vicinity of the proposed ACDI pineapple nursery would need to address the following concerns:

A. There are no reliable data available to describe the population characteristics, movement patterns, and herd sizes for key vertebrate or invertebrate indicator species in the area. This prevents any accurate prediction of probable impacts to wildlife or wildlife habitats. Indicator species will need to be identified for upper food chain mammals, aquatic macroinvertebrates, restricted endemic species, and baseline data gathered.

B. In association with baseline data about indicator species, delineation of habitat types in the area, and field inventories of habitat conditions will be needed. These data can be correlated with species data to indicate the present suitability of the area for wildlife populations.

C. Water quality sampling to establish pre-project baseline conditions, and guide qualitative interpretations of existing habitat and watershed conditions.

D. Water balance (quantity) studies to indicate baseline hydrologic conditions, and predicted changes that would occur under different land use scenarios.

E. Forest inventories should be conducted to classify vegetation types, and identify possible TES plant species, or other unique or endemic plant species which occur in the area. The genetic resources of this area are poorly known, at present. These inventories should also identify important timber and non-timber products found in the area.

F. Inventory the location and area extent of natural wetland communities found in the area. The analyses should also describe the hydrologic and ecological parameters necessary to sustain these communities, and indicate conservation measures necessary to minimize disruption of these aquatic systems.

G. Socio-economic surveys to delineate present land use patterns and indicate consequences of current land uses; the present and projected economic status of the population based on formal and informal earning practices; public health conditions and implications from increased earning and infrastructure opportunities; waste management capabilities; settlement patterns and potential problems; and social stratification and gender concerns.

Serious planning of a large scale commercial nucleus farm on the lands to the north and east of the proposed nursery should only be considered after careful analysis of all of these factors has been completed, and a thorough analysis of possible alternative means for accomplishing the desired goals of commercial pineapple development has been provided.

A P P E N D I X F

APPENDIX F

List of Persons Contacted

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Sunil Dimantha, Department of Land Use Planning, Mahaweli Engineering and Construction Company

Robert Flick, ACDI, Country Director

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