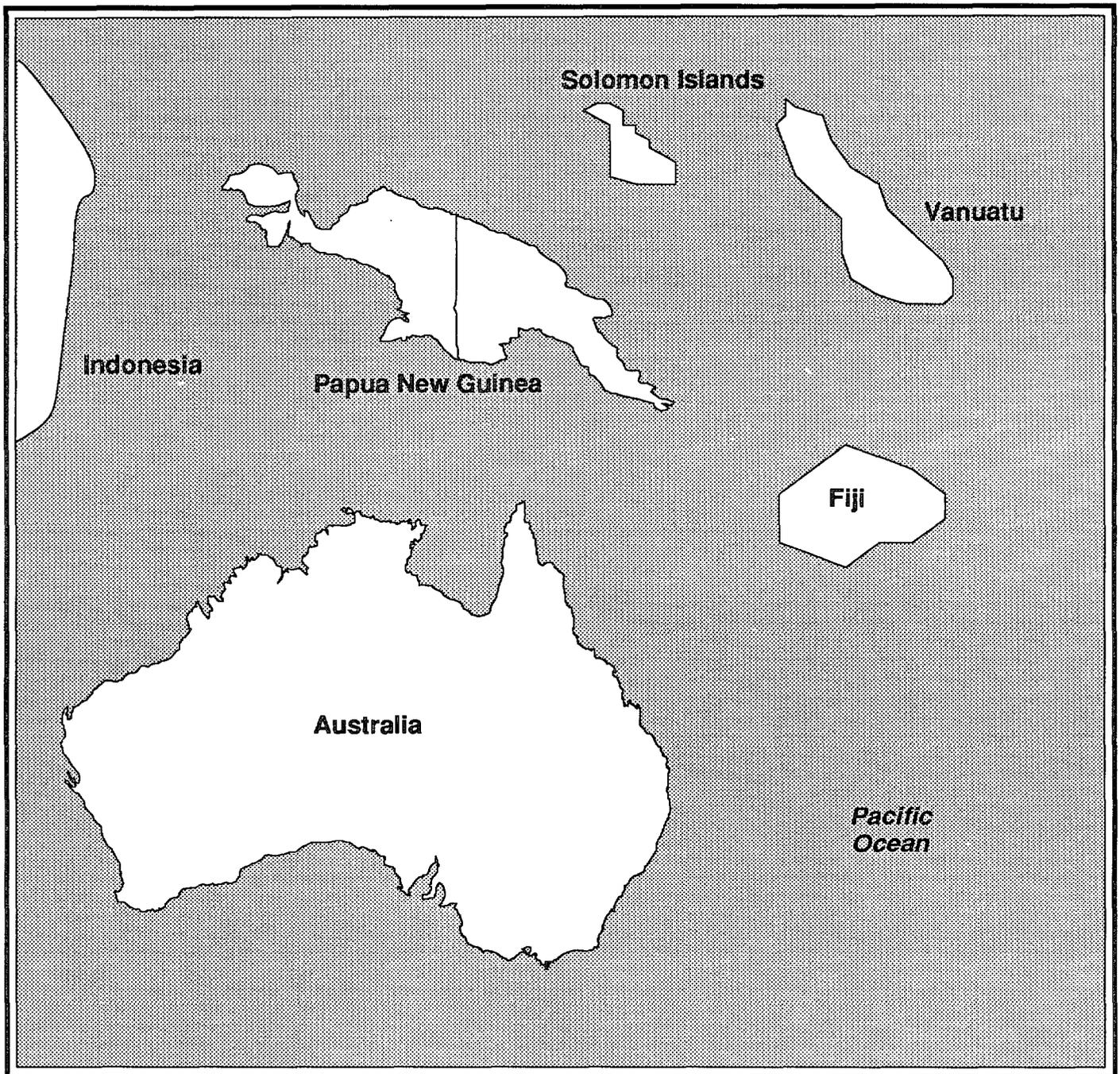


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# Programmatic Environmental Assessment

Sustainable Forestry Program  
for Papua New Guinea,  
the Solomon Islands, and Vanuatu



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United States  
Department of  
Agriculture

**Forest Service**



United States  
Agency for  
International  
Development



United States  
Department of  
Agriculture

**Office of  
International  
Cooperation and  
Development**

The Forestry Support Program (FSP) is managed jointly by the U.S. Department of Agriculture's Forest Service and Office of International Cooperation and Development (OICD) with funds provided by the U.S. Agency for International Development (USAID) Bureau for Research & Development (R&D) through its Office of Environment and Natural Resources (ENR).

**FINAL**

**PROGRAMMATIC ENVIRONMENTAL ASSESSMENT:**

**SUSTAINABLE FORESTRY PROGRAM**  
**for PAPUA NEW GUINEA, the SOLOMON ISLANDS, and VANUATU**

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## LIST OF ACRONYMS

EC	European Community
ETC	Ecological Training Company
FAO	Food and Agricultural Organization
FS	Forest Service
FSP	Foundation for the Peoples of the South Pacific
ITHL	Iumi Tugetha Holdings Limited
NEPA	U.S. National Environmental Policy Act of 1970
NGO	nongovernmental organization
PEA	programmatic environmental assessment
PNG	Papua New Guinea
RAN	Rainforest Action Network
RIC	Rainforest Information Center
SI	Solomon Islands
SOLTRUST	Soltrust Registered Fund Trustees Inc.
SPATF	South Pacific Appropriate Technology Foundation
UK	United Kingdom
UNDP	United Nations Development Programme
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
WARP	Woodworkers Alliance for Rainforest Protection
VSSP	Vanuatu Small-scale Sawmill Program

**DRAFT FINAL**

**PROGRAMMATIC ENVIRONMENTAL ASSESSMENT:**

**SUSTAINABLE FORESTRY PROGRAM  
for PAPUA NEW GUINEA, the SOLOMON ISLANDS,  
and VANUATU**

**EXECUTIVE SUMMARY**

The Foundation for the Peoples of the South Pacific (FSP) has initiated a program for sustainable community forestry in the Melanesian countries of Papua New Guinea, Solomon Islands, and Vanuatu. Melanesia is important due to its extensive primary tropical forests, extremely high biodiversity, and traditional forest ownership and community structure. Small-scale portable sawmill technologies are gaining popularity among traditional forest communities as an alternative to large-scale industrial logging, which has often caused extensive environmental damage and failed to produce community-level benefits. The new technologies, such as the "Wokabaut Somil", enable forest-owning communities to maintain control over the fate of their forests as well as profit from new economic opportunities.

The FSP program is designed to reduce impacts on forest ecosystems and forest-owning communities by providing assistance to improve portable sawmill operations, community networking, forest management, lumber processing, spin-off enterprises, and marketing. FSP will implement the program with partial funding under a 1990 matching grant from USAID which is designed to strengthen the institutional capabilities of FSP. With additional major support from other donors, the FSP program will result in the planned assistance activities. The FSP program proposal (updated in 1991, #15) outlines community forestry needs in the region. The program aims to improve forest management and the economic viability of Melanesian community enterprises engaging in the portable sawmill technologies and associated micro-industries. Through alliances with non-governmental organizations (NGOs), it will build local capacity to sustain the services initiated by the program.

In compliance with U.S. Agency for International Development (USAID) environmental regulations, potential environmental impacts of the program must be assessed and mitigated where appropriate. This document reports the results of a Programmatic Environmental Assessment (PEA), which will be used to guide the

implementation of the program.

Two alternatives were considered in the PEA. The program either will be implemented (proposed alternative) or won't be implemented (no action alternative). The alternatives are described in detail in Chapter 3, including tables projecting the number of sawmills and NGO partners and a detailed timeline of program activities. Appendix D provides a technical description of the "Wokabaut Somil".

The PEA team was composed of USDA Forest Service specialists and one Science and Diplomacy Fellow of the American Association for the Advancement of Science. Their assessment addressed the following primary issues:

- Soil and Water Resources
- Forest Vegetation
- Flora and Fauna/Biological Diversity
- Socioeconomics
- Training and Extension Services
- Wood Production and Marketing

The PEA found no significant environmental impacts associated with the planned implementation of the FSP sustainable forestry program in the three countries. There are sufficient safeguards and mitigation measures to proceed with implementation as long as a strong emphasis on continuous monitoring and evaluation of the program's administration, accomplishments, and on-the-ground applications is maintained. In fact, going forward with this program would be preferable to letting the existing situation run its unguided course. The affected environment and specific program effects under both program alternatives are addressed in detail in Chapter 4 and the PEA team specialist reports (#82).

Chapter 1 summarizes recommendations to guide the further planning, implementation, and evaluation of specific activities of the planned program. The recommendations supplement those mitigations already designed into the program, as described in Chapter 2, Section F. The recommendations focus primarily on development of pilot programs, first in the Solomon Islands, as well as preliminary forest inventories and marketing surveys, improved coordination among NGOs, country-level staffing, improved forest management planning and harvest prescriptions, monitoring and re-evaluation needs, and the priority information needs for a research component of the planned program.

This PEA was approved February 24, 1993. An Environmental Action Plan was developed to assign responsibilities and a time frame for implementation of the PEA's recommendations (See Appendix E). A letter from the USAID Asia Bureau Environmental Coordinator to the FSP Executive Director is attached as Appendix F.

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**PROGRAMMATIC ENVIRONMENTAL ASSESSMENT:**

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**CHAPTER 1. RECOMMENDATIONS**

The Programmatic Environmental Assessment (PEA) team found no significant environmental or socioeconomic impacts associated with the implementation of the Sustainable Forestry Program planned by the Foundation for the Peoples of the South Pacific (FSP) for three Melanesian countries, Papua New Guinea, the Solomon Islands, and Vanuatu. That conclusion is based on the explicit assumption that the program is implemented as planned, recommendations are followed, and impacts are mitigated as outlined in this report. There are sufficient safeguards for program implementation to proceed as long as a strong emphasis on continuous monitoring and evaluation of the program's administration, accomplishments, and on-the-ground applications is maintained. Going forward with this program is preferable to letting the existing situation run its unguided course.

The following summary of recommendations is provided to guide the further planning, implementation, and evaluation of specific activities and implementation sites that have not yet been determined for the planned program. These recommendations are based upon the assessments of specific issues described in Chapter 4 below, and upon a program assessment cutting across those issues. The recommendations should be considered as supplementary to those mitigations designed into the planned program, and described in Chapter 2, Section F. These recommendations have been incorporated into an Environmental Action Plan that assigns responsibilities and a time frame for implementation of each action (See Appendix E).

**A. SUPPLEMENTARY PROGRAM OBJECTIVES**

1. Increase the number of portable sawmills that join or stay in the FSP program. The program should place emphasis on designing, researching, and refining the "sustainable forestry" prescriptions, including the silvicultural and ecological management components.

2. Follow the recommended guidelines in this PEA, but view them as dynamic, so they may be improved as better information becomes available. The status of present knowledge (e.g. silvicultural systems, biological processes, resource inventory information, etc.) needed to guide this program is sorely lacking.

## **B. PROGRAM INITIATION AND ADMINISTRATION**

1. Define more precisely the specific cooperative roles and responsibilities for all stakeholder groups involved in the program, including USAID/Suva, FSP/San Diego, FSP Country Directors, Regional Coordinator, partner NGOs, host government agencies, and participant communities and sawmill operators.

2. In the early stages of the program, focus primarily on the Solomon Islands, where threats to remaining forests are greatest and program interventions would have the greatest impact; secondarily focus on Papua New Guinea (PNG);

3. Focus the program on pilot areas and activities in each country. The pilot program should include a sawmill operators' association, centralized secondary processing, sawmill operator network, and improved training and extension services. Use these pilots to gain experience and lessons before expanding country-wide.

4. Inventory all existing portable sawmill operations, and report locations and status of operations. A program priority should be to improve existing sawmill operations, especially those that are now inoperable.

5. Develop a regional database on people and organizations involved in portable sawmill technologies, community forestry, and sustainable forestry in order to facilitate technology transfer and lessons learned from program successes and failures.

6. Conduct a portable sawmill product market survey as a first priority.

7. A full-time Regional Program Coordinator is needed. This person should have strong capabilities in fund raising, program administration, and proposal writing with good qualifications in resource management. Additional staffing priorities should address on-the-ground needs, e.g. trainers, training content, extension agents, and local government coordination before regional administration needs as follows:

Papua New Guinea: Country Program Coordinator, 3-4 Trainers, Extension Service Specialist

Solomon Islands: 2-3 Trainers, Extension Service Specialist, Sawmill Engineer Consultant (1st month)

Vanuatu: Country Program Coordinator, 2 Trainers, Extension Service Specialist.

8. FSP's intentions for the program must be more clearly articulated to the partner NGOs and communities already involved in the program or considering participation.

### **C. TRAINING AND EXTENSION**

The success of the program depends on effective training and extension. The following needs were identified.

#### **Training:**

1. Contact media to announce upcoming training workshops and communicate technical information regarding portable sawmills and logging.
2. A 2-3 week course may be adequate, but consider offering follow-up and refresher courses.
3. Consider certifying trainers. Training on current technical information and communication skills should be made available to the trainers on a regular basis.
4. Monitor and evaluate the acceptance and effectiveness of training, including participant evaluations of training content and materials.
5. Continue investigation and revision of Rainforest Information Center (RIC) sustainable forestry guidelines used in training activities.
6. Develop two distinct levels of training, both basic and advanced. Basic training should include extensive training on engine oil checking, uses of different oils, air filter cleaning, oil-gasoline mixing for chainsaws and proper filing or grinding of saw blade teeth; additional specialized training in advanced topics should also be offered.
7. Provide incentive-based and affordable training. Consider inclusion of training fees in the total purchase price of the sawmills.

8. Coordinate with other institutions offering training to expand scope of training currently available (e.g. Bulolo, Unitech, Peace Corps).

9. Government licensing of portable sawmills should be contingent upon successful completion of a certified training course.

10. Improve the training manual by dividing the modules into sections. Clarify learning and performance objectives for each section and test the students based on those objectives. Include an evaluation of the training and trainers to be completed by each trainee at the close of each section.

#### **Extension:**

1. Coordinate with existing extension services to share staff and resources; involve government agencies and other NGOs.

2. Identify one or more highly motivated individuals in the target communities and develop extension services through those key people.

3. Develop portable sawmillers' associations for such functions as the sharing of information and expertise. Develop a database of sawmillers, which should include their skills, locations, and means of contact.

4. Exchange knowledge and practical experiences between the participating countries using, e.g. model site visits, trainer and extension agent exchanges, and inter-regional meetings.

5. Incorporate environmental awareness and the sustainable forestry model into school curricula.

6. Link the participating NGOs to government forestry offices by sharing resources and expertise to develop an extension program.

7. Develop provincial centers for the supply of parts and services, such as repairs, and for lumber treatment, secondary processing, and marketing.

#### **D. LAND USE PLANNING**

##### **Planning Considerations:**

1. Prepare overall landscape-level management plans and harvest plans for every project area identified. Harvest

plans should include harvest blocks and access delineations which avoid erodible soils and critical habitat areas. Compile this information within a format of management opportunities and constraints.

2. Keep the planning process as simple as possible in order to expedite implementation.

3. Identify local counterparts that can help in the preparation of management plans. Planning should incorporate the expertise of extension agents, forestry officials, members of forest-owning communities, and NGOs. Integral inclusion of the forest owners in the planning processes for their forests will add information based on their understanding of forest ecosystems and traditional uses as well as a better understanding of their needs.

4. Seek qualified technical advice in land use zonation, forest management planning, and integration of existing land use systems.

5. In the absence of adequate information to develop comprehensive and successful management prescriptions, forest entry and harvest practices should be designed to provide flexibility or adaptability of reaction to problems. This adaptability should be expressed in terms of management planning and maintenance of the forest's capacity to recover naturally from disturbances, including logging activity, expected natural disturbance (e.g. cyclones or drought), catastrophes (e.g. major disease outbreaks), and mistakes made in management prescriptions. Examples of prescribed adaptability include assisted natural regeneration with supplemental planting, expanded or replicated conservation areas to include buffer zones, and replicated monitoring and study plots.

6. Locate sawmills in the forest so that operating distances stay within 5 kilometers of the home village or road system; this distance is probably the most important factor in determining whether the portable sawmill project will be successful. Appropriate alternative means of access and lumber transport should be investigated.

#### **Environmental Considerations:**

1. Base harvest plans on an inventory of timber and non-timber resources, ecological status of stands, regeneration potential, and critical biological diversity conservation elements.

2. Include measures to protect and maintain critical species, e.g. pollinators and dispersers of valuable tree

species, and their habitat, e.g. wolf trees and snags. This will require a prior assessment of the functions and status of critical species and other conservation elements, such as unique or rare communities. Incorporate the results and recommendations from these assessments into individual forest management plans.

3. Reduce the introduction or spread of non-native invasive species, including timber species used in reforestation, agricultural escapees, and any others species which may reduce the viability or functions of natural forests.

4. Consider loosening the RIC guidelines to meet specific situations; for example, the 50 meter riparian protection zone may be shortened if the site gradient is near level. Such special zones should be recognized, but harvests within those zones may be justified on a case-by-case basis.

5. To reduce the damaging effects of log skidding, the following mitigation measures should be applied:

- a) Prevent construction of trails within 50 meters of a stream.
- b) Reduce skidding distances by placing sawmills closer to the trees.
- c) Place water bars or other diversionary devices along skid trails to reduce the amount of erosion.
- d) Where stream crossings are necessary, cross at right angles to the stream, rather than skidding down the stream channel.
- e) Remove logging debris from the stream channel.

6. Where access roads and trails must be built, reduce environmental impacts by employing the following guidelines:

- a) Locate roads as far from streams as possible.
- b) Plan the fewest possible number of roads.
- c) Apply erosion control measures, including drainage and surfacing.
- d) Re-vegetate the cut banks and road shoulders as soon as possible.

7. Determine appropriate restrictions on gradient; harvesting on slopes which exceed 30% will require mitigation measures as described in Chapter 4.

8. Because of the unavailability of adequate research on the effects of forest gaps on regeneration, determination of the appropriate gap sizes for sawmilling operations on specific sites should be based upon the best judgements of local landowners, scientists, and managers. Until that research becomes available, the conservative FSP program guidelines

(#26) for gap size should be used and monitored.

9. Consider a more clustered pattern for the configuration of the harvest blocks (Figure 1) instead of the systematic arrangement indicated in the RIC plan (#26); the clustered pattern more closely mimics a general natural disturbance pattern.

10. Determine appropriate harvest unit size according to different site requirements. The current one-hectare limit may be too restrictive for the low harvest rates and fluctuating market demands observed.

11. Incorporate post-harvest treatments, especially reforestation, in the harvest plan.

- a) Replant cut areas to signify a commitment to forest management.
- b) Release desired seedlings from vine and other vegetative damage.
- c) Promote community tree nurseries to provide needed seedlings of genetically-local stock for reforestation of community forests.

#### **E. SOCIOECONOMICS**

1. The planned program should better reflect socioeconomic issues, especially the complex ownership patterns, traditional land use systems, decision making mechanisms, methods of benefit distribution, community-level social structures, and the role of women (Refer to #82B). Planners and program officers should be aware of or learn about those issues and traditions.

2. Insure that rights and benefits accruing to program participants flow through the complex tenure and ownership systems to the recipients desired by the community. Beware of false assertions of ownership or benefits by individuals. Build upon existing and traditional social units and decision-making processes.

3. Traditional land use rights and practices should be incorporated into land management plans designed for portable sawmill technologies.

4. Encourage local community participation, including from women, at all project stages to incorporate their knowledge, assure compatibility, gain their support, and build local capacity.

5. Find appropriate ways to communicate with women and assure their participation, avoid unintended increases in

their workload, and receipt of benefits. Associated projects, such as guesthouses built from community produced lumber, are promising opportunities.

#### **F. WOOD PRODUCTS AND MARKETING**

1. Make sure the market requirements are known before cutting timber, and use the timber more efficiently. Basic guidelines include the following:

- a) Minimize damage to the main stem during felling.
- b) Buttressed butts should be cut off.
- c) In most instances, at least one more cut could be made with the portable sawmill on the bottom or residual slab than is usually practiced; do so by carefully cradling and holding the log in place; alternatively, reverse the slab face-to-face on top of another bottom slab and then saw.
- d) Lumber should be dried properly by stacking under a well-ventilated cover; separate boards with stickers of uniform size (2 centimeters), and spaced not more than 60 centimeters apart; place the stickers in each course directly in line with one another.

2. Use solar drying kilns to reduce the moisture content of the wood to make transportation more efficient.

3. Demonstrate all aspects of treating timbers. Develop cost data to determine whether there is a relative advantage in selling treated timber.

4. Utilize sawmill associations to uncover business information such as:

- a) product demand;
- b) buyer specifications;
- c) new ways to offer a consistent product; and
- d) competitive prices.

5. Produce attractive literature and sample materials promoting the different tree species available. Utilize sawmill associations and participate in international trade shows and trade missions.

6. The sawmill associations should also establish regional concentration yards with capabilities for lumber drying and treatment, recutting and surfacing, secondary processing, and marketing. Those facilities would provide concentrated volume and add value to the products at a relatively low cost, and capital investment and overhead expenses would be minimal.

7. Consider redesigning the present sawmill to lessen its weight, decrease friction and shaking, sustain saw blade lubrication, and utilize a spacer to keep the wood from pinching the saw.

8. The assessment team disagrees with the apparent emphasis on "green stamped eco-timber" as the first priority of the FSP program (#26). The argument for this approach overstates any realistic program benefits (e.g. estimates of sawmill income); instead, initial marketing efforts should firmly establish the local and national market structures before attempting even normal export market development.

#### **G. RESEARCH**

1. Foremost among research needs is a land-base inventory of forest types, commercial species quantity, and locations. In addition, research should be focused on answers to questions that address critical forest management problems, e.g. harvesting designs, and gap size and configuration effects (Refer to #82C). This might be accomplished by literature reviews, consultations, and specialist workshops, and it should be funded directly and immediately by FSP.

2. A subsequent level of research should address the long list of complex, long-term, and academic problems of forest ecology and management and community forestry in close coordination with universities and appropriate international research organizations.

3. Priority forest ecology and management research needs include, but are not limited to, the following topics:

- a) natural regeneration and silvicultural requirements of desirable or critical species;
- b) forest disturbance dynamics, including gap size and configuration effects on natural regeneration and biodiversity;
- c) status and habitat requirements of critical species, including old-growth forest dependents; and
- d) genetic provenances of desirable tree species.

#### **H. MONITORING AND RE-EVALUATION**

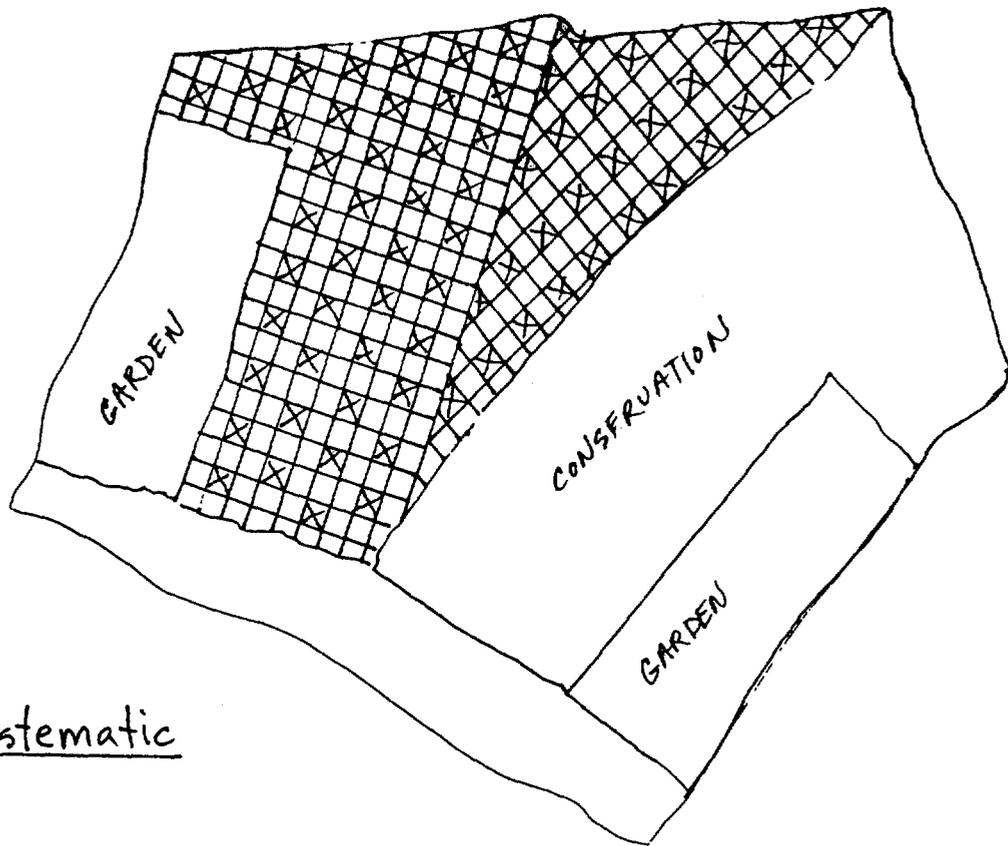
1. Monitoring will validate the effectiveness of the sustainable forestry prescriptions and guide the modification of program guidelines, and it will help answer research questions. Monitoring should focus on forest management areas, comparing harvest and non-harvest blocks, and include the following goals.

- a) Characterize the forestry practices of portable sawmill users.
- b) Inventory and assess status of desirable tree species and regeneration as well as impacts due to forestry practices.
- c) Inventory and assess status of critical species and community types as well as impacts due to forestry activities.
- d) Correlate the above with canopy gap characteristics.
- e) Assess the success of replanting and reforestation efforts.
- f) Assess the acceptance and effectiveness of the training and extension services.

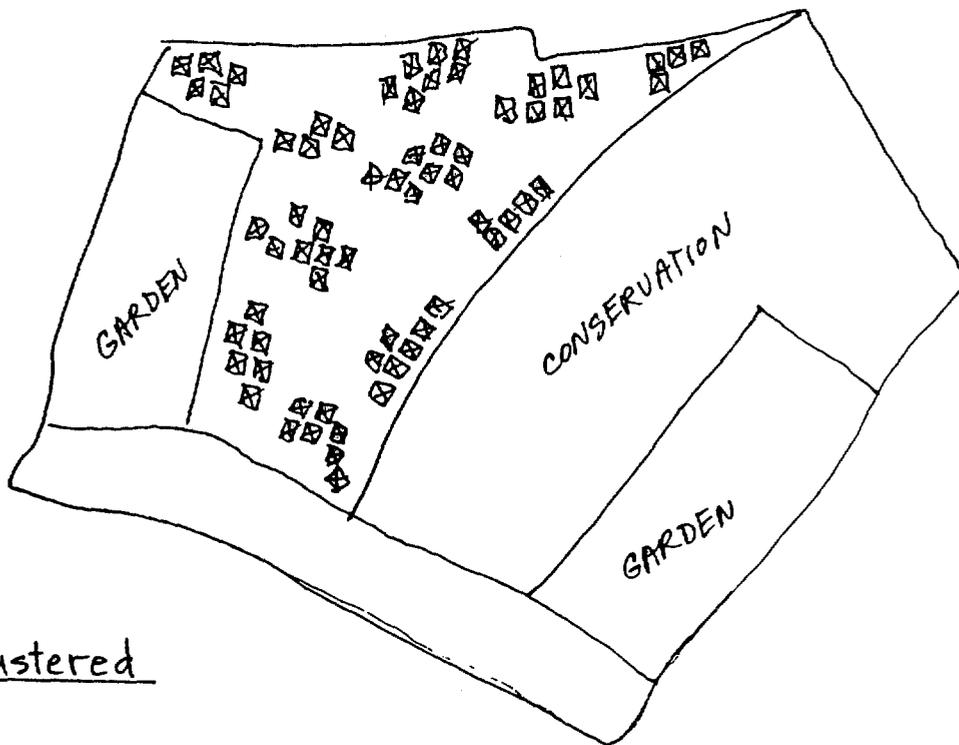
2. The information collected in the PEA record and collected as a result of the above research and monitoring activities should be distributed to all FSP and affiliate offices with responsibilities for forest management. In addition, training and leadership opportunities, e.g. study sabbaticals, study tours, and research grants, should be provided to forest management personnel, especially those in the field.

3. Re-evaluations of program progress, including incorporation of recommendations from this PEA and adherence to the Environmental Action Plan, should be conducted annually by USAID, within one month after the close of each fiscal year; teams of 2-3 Forest Service specialists might be available for this purpose under an arrangement with the Forestry Support Program similar to that which provided the current PEA team.

4. A review of FSP's Vanuatu program during its first 2 years was in progress at the time of the PEA team's visit. The results of this review should be examined and incorporated into the program plan.



Systematic



Clustered

Figure 1. Harvest Block Configuration

## CHAPTER 2. PROGRAM SCOPE

### A. PROPOSED ACTION

Papua New Guinea, the Solomon Islands, and Vanuatu are located in the southwestern portion of the South Pacific region called Melanesia. Melanesian forests are among the most significant of all Old World tropical forests, in terms of both biological diversity and economic resources. Yet these countries are among the poorest in the South Pacific region. Timber exploitation and mineral extraction is accelerating, due in part to rapidly growing populations and rates of commercial development as well as the fact that many of the Southeast Asian forests have been largely exploited. Melanesia is also unique in its great cultural diversity and constitutional protection of customary land ownership.

The large-scale extractive logging practices currently used by foreign timber companies have been problematic for several reasons: few benefits have directly reached the forest-owning communities; forest regeneration has been poor; and degradation of forest environments has been severe. As an alternative, a growing number of forest-owning communities are adopting small-scale portable sawmill technologies which they may operate and from which they receive direct profits. The planned Sustainable Forestry Program will address needs in community development and sustainable forest management that have been raised by the application of those new forestry technologies. This document reports the results of a programmatic environmental assessment, which will be used to guide the Foundation for the Peoples of the South Pacific (FSP) and its partner NGOs in the implementation of the planned program.

### B. PROGRAM PLANNING AREA

**Papua New Guinea:** Papua New Guinea (PNG) has a land area of 46.8 million hectares and a sea area of over 30 million hectares. The largest part of the country (85%) comprises half of the island of New Guinea, which is the world's largest and highest tropical island. PNG contains great natural and cultural diversity -- most types of equatorial environment (except deserts), very high biotic endemism and diversity, and one of the highest concentrations of distinct languages in the world (#32). Forested areas in PNG cover approximately 36.4 million hectares, about half of which are considered commercially valuable (#23). About 50% of those commercially valuable forests are lowland rainforests, which contain the greatest number of valuable timber species and are relatively more accessible on coastal plains.

The present population of PNG is estimated at 3.7 million, more than 85% of which is rural, with an estimated growth rate of 2.3% per year.

**Solomon Islands:** The Solomon Islands cover 3.1 million hectares of land and over 259 million hectares of sea in six larger and scores of smaller islands (#24, #33). There is a shortage of land and only forestry and fisheries offer potential for future economic growth (#33). Forested areas in the Solomon Islands cover approximately 2.5 million hectares, of which only 7.6% has not been exploited by conventional logging enterprises or cleared due to agriculture or storm damage (#33, #42). Approximately 90% of all forested land is the valuable lowland rainforest type (#17).

The present population of the Solomon Islands is estimated to be 285,178, about 82% of which is rural. The population is growing rapidly at the rate of 3.5% per year (#33).

**Vanuatu:** The Vanuatu archipelago consists of a Y-shaped chain of about 80 islands. Of the total land area of 12,000 square kilometers, the largest island, Santo, accounts for approximately one-third of the total area (#34). Most islands are mountainous and rugged. About 900,000 hectares (75% of the total land area) is covered by natural vegetation; however, most of the forested lands are too steep for logging or contain little timber of value for conventional logging enterprises (#34).

The present population of Vanuatu is estimated to be 136,000 and growing at the rate of 3.0% per year. Nearly 82% of the population live in rural areas, and approximately 48% are under 15 years of age.

### **C. MANAGEMENT DIRECTION**

The planned Sustainable Forestry Program will be implemented by the Foundation for the Peoples of the South Pacific (FSP) with funding from a matching grant awarded by the U.S. Agency for International Development (USAID) Bureau for Food and Humanitarian Assistance, Office of Private and Voluntary Cooperation. The matching grant from USAID is designed to strengthen the institutional capabilities of FSP. Under an eight year period, the FSP program will establish an NGO consortium project for sustainable forestry development using portable sawmill technologies and associated micro-enterprises (#26). With additional major support from other donors, the FSP program will result in the planned assistance activities.

USAID-supported activities are subject to the Environmental Procedures of Title 22, Code of Federal Regulations, Part 216, which are based upon the National Environmental Policy Act. Further, USAID activities that may involve significant loss of

tropical forests or commercial timber extraction in primary tropical forest areas require an environmental assessment according to the FY91 Foreign Assistance Appropriations Act, Section 533(c)(3). That assessment must address minimization of impacts on biological diversity, maintenance of forest ecological functions, and reduction of deforestation. In addition, the Foreign Assistance Act, Sec. 118 requires environmental assessments for development assistance programs involving tropical forests. Following USAID's Environmental Procedures, an environmental assessment was required for the planned program, and is the subject of this report. This environmental assessment will be reviewed for approval by the Environmental Coordinator of USAID's Asia Bureau.

The Foreign Assistance Appropriations Act also requires a consistency between existing US and host country regulations. Therefore, the environmental legislation and policies of each host country in the planned program were reviewed (#8, #41, #43, #74, #93, #95). In addition, scoping sessions were held with government officials, NGOs, scientists, and forest-owning communities in each country (#54, also see Appendix B). All countries have legislation and policies that encourage development of village economies and the sustained yield of forest resources which are consistent with both of the alternative actions (No Action and Proposed Action) examined.

#### **D. PURPOSE AND NEED FOR ACTION**

A forest conservation planning process is slowly being developed by a small number of forest-owning communities, assisted in part by local and international NGOs. Conservation planning at the community level has not yet been widely institutionalized by communities or the government. Government involvement is limited by low funding and the necessity for cooperation with communities whose land ownership is protected by the PNG Constitution. However, interest in assisting forest-owning communities appears high and the opportunity for a collaborative initiative with country governments, landowners, and an NGO consortium is timely.

The forests of all three countries are suffering degradation from large-scale international logging operations and, in isolated cases and to a much lesser extent, from portable sawmill usage (#15). Where large-scale logging operations have been carried out, deterioration of water quality, soil productivity, village subsistence capability, wildlife and plant habitat, and off-shore reef systems have often resulted. Portable sawmills (including "wokabout sawmills"), are abundant and underutilized, and are preferred by forest-owning communities over large-scale logging for most of the above reasons. Misapplication of portable sawmill technologies, however, has also caused some localized environmental damage and negative socioeconomic impacts in forest-based communities.

During the past decade, portable sawmills have been sold to many individuals and communities as a new technology to meet local lumber needs and/or to derive local income (See Appendix D for more information). More than half of the approximately 750 portable sawmill systems known to have been sold are no longer in operation, primarily because of the lack of extension services and good quality training programs. In addition, studies have demonstrated that whole log prices are low and logging-based income to governments is minimal and near negligible to the customary forest-owning communities (#55). A marketing structure to support the small local economies based on portable sawmills is lacking or inconsistent except near larger cities such as Port Moresby or Lae in PNG, Honiara in the Solomon Islands, and Port Vila in Vanuatu.

The planned program's target beneficiary groups are the families of small communities. The program is not intended to provide large grants for specific village projects. Instead, the program will address the primary need to upgrade local capabilities in forest management and sawmill operation as well as to improve the economic viability of community-based portable sawmill operations and associated micro-industries.

#### **E. PROGRAM OBJECTIVES AND BENEFITS**

The objectives of the planned program are broad in scope because specific activity sites and sub-projects will not be determined until the program is initiated. More detailed information about the planned program will be found in Chapter 3, the FSP draft document, "Sustainable Forestry Planning" (#26), and the narrative describing the "wokabout somil" (Appendix D). Primary objectives of the planned program are listed below.

1. Build alliances between FSP and viable NGOs, businesses and government agencies in each host country to cooperate on sustainable forestry initiatives.
2. Provide support services, including training, extension, and communication networks, for small businesses associated with the participating NGOs and coordinate complementary activities.
3. Assist in the development of economically viable cooperative enterprises associated with the portable sawmill technologies.
4. Promote environmental awareness activities and increased community involvement in natural resource use and environmental protection decisions and planning.
5. Assist in development of capabilities and provide services for forest management research and continuous

monitoring of impacts associated with portable sawmill activities.

6. Integrate the above objectives and activities with those of the national forestry and environment agencies of each host country and facilitate appropriate modifications in forest management legislation and policy.

The planned program is designed to generate activities that will produce the benefits listed below.

1. Increase the ability of Melanesians to integrate the use, control, and management of their forest resources in a manner that achieves sustainability of forest ecosystems and forest-owning community culture and economies.

2. Improve employment and incomes from portable sawmill and associated micro-enterprises.

3. Minimize impacts on biological diversity, maintain natural forest functions, and reduce deforestation in forest management activities of the host countries.

#### **F. MITIGATION MEASURES INCORPORATED INTO THE PLANNED PROGRAM**

The following mitigation measures were developed by the Foundation for the Peoples of the South Pacific (FSP) for implementation of the planned Sustainable Forestry Program at specific sites (#26). These measures, or slight variations of them, are being applied for the few projects already under the guidance of FSP in the study area. To validate the effectiveness of those mitigation measures, the PEA team reviewed specific projects at the sites of application that have occurred over the last four years. In addition, field trips were conducted to several sites where the mitigation measures were not used.

Additional evaluation and monitoring, beyond the PEA team's initial assessment, is needed. For instance, it is highly probable that the prescribed silviculture systems and their respective mitigation measures will vary by country, land form, ecological community, and/or specific management objectives of the landowners. The mitigation measures discussed below as well as relevant measures recommended in Chapter 1 will be incorporated into an Environmental Action Plan that will assign responsibilities and provide a time frame for implementation.

##### **F.1. Planned Mitigation Measures**

The mitigation measures specifically prescribed in the planned FSP program are summarized below (Refer to Annex 1 of #26):

**Pre-harvest Planning:** Any timber harvest project utilizing portable sawmills will be implemented only after several planning steps have been taken.

1. A land use plan will be developed and reviewed.
2. The timber stands will be inventoried, and their harvestable volumes will be calculated.
3. A specific harvest plan will be developed, with 1 hectare harvest blocks and undisturbed strips delineated.

**Harvest Guidelines:** Following the harvest plan, harvesting will take place as follows.

1. Alternate 1 hectare blocks (e.g. 1, 3, 5, etc.) will be logged at a rate of no more than 10-15 trees/hectare; the other blocks (e.g. 2, 4, 6, etc.) will be cut no sooner than 25 years later.
2. Harvest only those trees greater than 55 centimeters diameter at breast height, even if fewer than 15 trees of this size are available.
3. Fell logs in directions that will concentrate and reduce damage to residual trees and regeneration; retain enough canopy to achieve a desirable mix of light-intolerant dominant species.

**Sawmill Site and Accessways:** Conduct clearing for the sawmill work site and accessways to minimize disturbance.

1. Minimize clearing for the sawmill and limit sawmill sites to 5 per hectare (i.e. no more than three trees per sawmill site).
2. Minimize extraction trails and locate them away from fragile features, such as wildlife nest trees and stream courses.
3. Winch logs to the mill site rather than cutting log ramps from other trees.

**Reforestation:** Assist forest regeneration where trees have been felled and other disturbance has occurred.

1. Plant at least 5 wildlings (0.5 to 1 meter tall) of the same species as those harvested in the sawdust residue remaining from the sawmilling operations in the clearings created; plantings should be no closer than 3 meters apart; return to weed and thin these plantings after several months.

**Protection of Riparian Zones, Wildlife Habitat, and Soils:**  
Protect riparian zones, wildlife habitat, and soils.

1. Maintain large limbed "wolf" trees and dead snags as wildlife habitat elements.
2. Fell no trees within 50 - 100 meters from stream courses.
3. Do not log on slopes of greater than 15% gradient.

**F.2. Comparison of Alternatives**

Table 1 is a comparison of Alternative 1 and 2 for selected criteria. Detailed information about the alternatives can be found in discussions in Chapter 4, Appendix D, and the PEA team's Specialist Reports (#82).

**G. OBJECTIVES OF THIS PROGRAMMATIC ENVIRONMENTAL ASSESSMENT**

This is a programmatic environmental assessment (PEA). The modifier "programmatic" refers to the fact that the planned program under assessment will coordinate a set of as yet unspecified sub-projects at undetermined locations as well as general support activities such as advising, training, extension, and demonstrations at as yet unspecified locations. This assessment therefore provides a set of guidelines for implementation of the program. It also offers recommendations for mitigation measures to address components of the planned program which may cause or contribute to negative environmental impacts. Specific PEA objectives are listed below.

1. Identify potential adverse environmental impacts of the planned program pursuant to USAID regulations and relevant federal laws.
2. Determine guidelines for use in program planning, implementation, and evaluation of specific activities.
3. Determine measures for incorporation into the planned program which will mitigate identified adverse environmental impacts, lessen cumulative impacts in the region, and generally improve the efficacy of the planned program to accomplish its objectives.

It is outside the scope of this assessment to address issues related to the large-scale industrial timber harvesting presently underway in the host countries or to disclose the environmental effects of applying the portable sawmill technology to specific sites, e.g. plans for specific village harvest activities.

A primary assumption of this PEA is that the impacts, guidelines, and mitigation measures identified in this document will be recognized and incorporated into the planned program by the implementing organization, FSP, and its partners. Program implementation will not commence until the Environmental Coordinator of the USAID Asia Bureau has given final approval of this PEA.

## **H. ISSUES**

Key environmental impact issues were identified in the scoping process (Refer to Appendix B). Each issue is described below.

**Soil and Water Resources:** Water quality, water quantities, and soil productivity have been adversely affected by current practices of large-scale industrial logging, cash crop activities, portable sawmill operations, and subsistence gardening due to exposure and disturbance of the soil. In some parts of the study area, soil erosion and resultant sedimentation of streams have adversely affected off-shore reef ecosystems.

**Forest Vegetation:** Natural forest cover, composition, and function have been adversely affected by current practices of large-scale industrial logging, cash crop activities, portable sawmill operations, and subsistence gardening due to forest clearing. Rates of deforestation or degradation of primary natural forest have been increasing, and the most extensive losses are in the Solomon Islands and Vanuatu. In some parts of the study area, forest has been converted to unwanted grassland, largely due to frequent burning practices.

**Flora and Fauna/Biological Diversity:** Current practices of large-scale industrial logging, cash crop activities, portable sawmill operations, and subsistence gardening have also caused habitat degradation and fragmentation of natural ecosystems as well as introduction of invasive exotic species in some parts of the study area, especially the Solomon Islands and Vanuatu. Significant losses and threats to biological diversity have been identified in each country.

In addition, scientific knowledge and literature available on the biology and ecology of Melanesian natural forests is very limited; consequently, impacts due to many elements of forestry practices cannot be predicted with accuracy. Therefore, training and extension activities that develop prescriptions for forest management will be limited, and research and monitoring activities are needed to address those limitations.

**Socioeconomics:** Populations have been increasing; consequently economic and social pressures have been placed on the traditional cultural systems and forest management practices. Melanesia's unique and complex traditional patterns of land ownership and

use, decision-making mechanisms, the roles of women, and benefit distribution systems are critical factors in the planning, implementation, and monitoring of a successful sustainable forestry program. Portable sawmill and associated enterprises provide new sources of income and employment which affect those traditional patterns.

**Training and Extension Services:** Many portable sawmills are no longer in operation due to the lack or inadequacy of training and extension services. Such assistance, as well as environmental awareness programs, is essential for successful maintenance of enterprises based on portable sawmills.

**Wood Production and Product Marketing:** Current problems in the application of portable sawmill technologies include poor maintenance and repair of sawmills, inefficient timber utilization, lack of secondary wood products enterprises, irregular output of products, and poor marketing of products. Cooperative systems for sustained output and marketing are a promising mechanism to address those problems.

**Issue Raised But Not Considered - Air Quality:** Air quality in the host countries is generally good, except near major metropolitan areas where automobile pollution is high. After several field trips to portable sawmill operations, no detectable adverse effects on air quality were observed. Therefore, air quality was dropped from further consideration.

Many of the impacts associated with the above issues are the result of current weaknesses in forestry skills, marketing mechanisms, and government regulatory controls and services. Increased portable sawmill activity associated with the planned program may cause minor additional adverse environmental impacts. However, the PEA Team expects that such impacts will be limited to small areas where the program's training and support services are unsuccessful or misapplied. The program is designed to improve forest management practices, including protection of the environment and improvement of the economies of forest-owning communities, associated with a pre-existing and growing portable sawmill industry. Therefore the PEA team expects that the program will be primarily beneficial.

#### **I. PROGRAM COORDINATION AND STAFFING**

Overall program funding and integration will be coordinated by an FSP program office in Port Vila, Vanuatu. Specific in-country coordination and implementation will be guided by the respective FSP Country Director Offices in Papua New Guinea, Solomon Islands, and Vanuatu. The projected life of the program is eight years and the total matching grant budget is US\$1.6 million. Continuance of the program will depend upon and be guided by periodic monitoring and evaluation prescribed in the existing

program plan (#26). Specific staffing requirements are estimated in the FSP program plan (#26).

#### **J. PROGRAM MONITORING**

Consultants external to USAID and FSP will be utilized at periodic intervals for program monitoring and evaluation during the projected program life. Specific program monitoring activities and responsibilities will be determined and described in detail by FSP prior to program implementation. Chapter 1 provides a summary of recommended monitoring activities for portable sawmill operations associated with the program.

#### **K. EVALUATION CRITERIA**

The following evaluation criteria were used by the PEA team to evaluate issues, achievement of program objectives, description of affected environments, and disclosure of environmental impacts:

- Narrative on soil and water resources
- Narrative on forest vegetation
- Narrative on flora and fauna
- Narrative on biological diversity
- Narrative on training/extension services
- Narrative on wood products, sawmilling, and marketing
- Number of portable sawmills available
- Number of portable sawmills actively operating
- Number of portable sawmills that are inactive
- Number of NGO partners in the program
- Number of hectares impacted by sawmills per year
- Cubic meters of lumber produced per year
- Net profits from sawmills per year
- Gross income from sawmills per year

#### **L. ASSESSMENT TEAM FORMATION AND PROCESS**

In January 1992, FSP, USAID, and the USDA Forest Service entered into an agreement to conduct this programmatic environmental assessment (PEA) of the planned FSP program (#26). The team's assignment was to evaluate and disclose the environmental effects of the planned program and to develop general guidelines for use by FSP in program implementation.

Five Forest Service specialists and an American Association for the Advancement of Science (AAAS) Fellow were selected for the interdisciplinary team (See Appendix A). Participation by the team members was supported by USAID, the USDA Forest Service Tropical Forestry Program and Forestry Support Program, the participant's Forest Service home units, and the AAAS Science and Diplomacy Fellowship Program. Logistical coordination and support as well as hosting of field visits were provided by the

FSP country offices and partner NGOs, including Village Development Trust of Lae, PNG, and SOLTRUST of Honiara, the Solomon Islands.

The PEA team left their home bases of work and arrived in Papua New Guinea on February 20, 1992 to start a six week evaluation process. The team studied in Papua New Guinea until March 12th. From March 12 to 18, they visited the Solomon Islands and Vanuatu. On March 19, the team arrived in Suva, Fiji to complete the drafting of their report. A meeting was held on March 25 with USAID/Suva, FSP, and selected associate NGO participants to report the PEA findings. The PEA team was disbanded and returned to their respective duty stations on March 26, 1992.

A copy of the draft programmatic environmental assessment and a complete set of documents listed in the project record (Appendix C) were supplied to FSP and USAID in Suva, Fiji on March 24, 1992. Appendix B provides a list of contacts made during the scoping process and a brief scoping itinerary. Scoping worksheets that document the specifics of each contact made, can be found in the project record (#54).

Appendix C contains a complete index of documents reviewed in this interdisciplinary team process. Specific documents are referenced in the assessment text by their respective Project Record Index number in parentheses, e.g. "(#47)".

Chapter 1 contains the PEA team's recommendations for program implementation. Those recommendations are also provided to prioritize the program implementation sequence and improve the program focus. The planned program's guidelines to mitigate potential impacts of future implementation at specific sites are discussed above in Section F, and are taken into consideration in the discussions of the affected environment and environmental consequences in Chapter 4.

**Table 1. Comparison of Alternatives for Selected Criteria.**

<b>Criteria Description</b>	<b>Alter. 1</b>	<b>Alter. 2</b>
<b>Sawmills Available - number</b>		
Year 1	729	729
Year 8	1453	1803
<b>Sawmills Active - number (% of available)</b>		
Year 1	367 (50%)	435 (59%)
Year 8	920 (63%)	1310 (72%)
<b>Sawmills Inactive - number (% of available)</b>		
Year 1	362 (50%)	294 (41%)
Year 8	533 (37%)	493 (28%)
<b>Portable Sawmill Lumber Production - cubic meters</b>		
Year 1	66384	97416
Year 8	179424	328762
<b>Lumber - Gross Income - millions US\$/year</b>		
Year 1	18.7	22.4
Year 8	46.0	74.9
<b>Lumber - Net Profits - millions US\$/year</b>		
Year 1	1.64	1.95
Year 8	4.36	6.58
<b>Area Impacted - hectares/year</b>		
Year 1	460	460
Year 8	4079	6240
<b>NGO Partners - number</b>		
Year 1	7	7
Year 8	12	19

## CHAPTER 3. ALTERNATIVES

### A. GENERAL DISCUSSION

The Programmatic Environmental Assessment (PEA) team determined that this assessment requires evaluation of only two alternatives which are described below. The PEA team recognized that variants to the proposed action could be developed to fill the range of actions between the two alternatives; however, most of the variations considered by the PEA team were, in principle, identical to the proposed action, but would vary only in minor implementation mechanisms. Therefore, the team determined that two alternatives adequately covered the range of expected environmental impacts. Assumptions used to characterize each alternative were developed by the team and based on personal interviews of each of the Country Directors representing the Foundation for the Peoples of the South Pacific (FSP) (#69, #86, #112).

The team developed recommendations for additional program content as well as implementation priorities to improve the program planned by FSP (#26; Refer to Chapter 1). Guidelines are recommended for improvement of site-specific applications of the portable sawmill technologies. The team predicts that the environmental effects as disclosed in this document will be reduced by application of the recommended guidelines.

A summary of program circumstances in each host country under the two alternatives is provided below. In addition, a summary of projected statistics for portable sawmill use and non-governmental organization (NGO) partnerships under Alternatives 1 and 2 is provided in Tables 2 and 3, respectively. The time frame used spans the next eight years, which coincides with that described in the FSP plan (#26), thereby providing an equal time basis for evaluation of differences between the alternatives.

### B. ALTERNATIVE 1 (No Action)

Alternative 1 is defined as the expected course of events of FSP's planned sustainable forestry program using portable sawmill technologies without the support derived from the USAID matching grant.

**Papua New Guinea:** Presently, FSP has two primary NGO partners in Papua New Guinea (PNG) -- NADEQUIP and Village Development Trust (VDT). FSP's headquarters are located in Port Moresby, the other partners in Lae. NADEQUIP, a for-profit private company, currently manufactures and sells 75 sawmills per year with no plans to expand their production. VDT presently provides training services to sawmill purchasers as well as extension

services to the four sawmills presently affiliated with the FSP sustainable forestry program. VDT has a current staff of three trainers plus a Project Coordinator in Morobe Province.

FSP is also working with Rainforest Information Center (RIC) of Australia, Rainforest Action Network (RAN) of the U.S., Ecological Trading Company (ETC) of the U.K., and Woodworkers Alliance for Rainforest Protection (WARP), a local NGO. RIC has assisted with planning and silvicultural guidelines for field operation of portable sawmills. RAN is conducting potential product marketing surveys in the United States. ETC markets timber and, with WARP, is developing general guidelines for forestry products and practices to meet standards of sustainability.

At present, the PEA team is aware of no other foreign assistance programs focusing on portable sawmills. Therefore, many villages now considering their income options, such as community-based portable sawmill enterprises vs. large-scale industrial logging, will choose the latter. And some government initiatives, such as the Department of Environment and Conservation's Conservation Area program, will be further limited in success. Therefore, without USAID program assistance, FSP will lose credibility and the existing village projects may fail in 2 to 3 years (#69); the existing FSP program will be set back while new funding sources are developed.

**Solomon Islands:** Presently FSP has two primary NGO partners in the Solomon Islands -- Soltrust and Iumi Tugetha Holdings Ltd. (ITHL). Both are headquartered in Honiara. The three NGOs have a very close working relationship and share offices and equipment to jointly save costs. The training and extension services of the planned program are currently provided by Soltrust. Soltrust's staff includes an Executive Secretary for the Board of Directors, one Eco-Forestry Program Manager, one Eco-Forestry Officer, and an extension agent in addition to office personnel. ITHL is a for-profit partner company to Soltrust for commercial activities (e.g. sawmill manufacturing and lumber marketing).

Funding for the FSP program in the Solomon Islands has fallen short of expectations and needs during the past 2-3 years. Consequently, its progress and activities are in danger of stalling and the three NGO partners have been forced to become more inter-dependent and efficient in operation.

Six portable sawmills were purchased for use in the country for the first time in 1986. Since then, ITHL has developed the capability to manufacture about 50 sawmills per year, but production was suspended in June 1991. That year, 8 sawmills were completed and delivered to cooperating community groups. Five additional sawmills were recently ordered from a manufacturer in Port Moresby, PNG, SPATF, a former partner to

FSP. However, the mills were never delivered and Soltrust's money is presumed to be lost due to SPATF's internal troubles and near demise.

ITHL has been successfully marketing lumber in cooperation with ETC. In April, June, and September of 1991, 8 containers of lumber treated with methabromide were shipped to the UK at an average volume of 18.9 cubic meters per container. Another 6 containers were shipped in November of 1991, but ETC has failed to pay for the lumber. This has added another financial and credibility set-back to FSP's program for the Solomon Islands.

As in PNG, the Solomon Islands program will suffer seriously if USAID or other funding is not provided soon. The NGO partners have initiated other fund raising efforts to keep their program viable, but all will lose credibility which will require additional effort to rebuild.

**Vanuatu:** FSP has had a sustainable forestry program functioning in Vanuatu since 1990, primarily funded by the European Community (EC). The Vanuatu Small-scale Sawmill Program (VSSP) is a joint project between FSP, which is responsible for administration and management, and the Vanuatu Department of Forestry, which is responsible for technical supervision (#86).

The VSSP is designed to be conducted in four primary phases: (1) technology demonstration; (2) industry training; (3) industrial infrastructure development; and (4) timber utilization investigations. The first phase has been completed, and the second has been initiated. There are presently 6 community sawmills affiliated with the program; and, by the end of the 5-year program, they expect to have 30. A detailed summary of the original grant proposal and project framework can be found in the project record (#86).

A committee of both government and non-government associates oversees the program. Due to funding shortfalls, there has been no project manager since 1991.

### **C. ALTERNATIVE 2 (Proposed Action)**

The original FSP proposal to USAID was submitted in 1990 (#15). Subsequently, in late 1991, Stephen Berwick was contracted by FSP to update and describe the program. His final report was completed in early 1992 (#26); detailed descriptions of program activities and priorities can be found on pages 24-31. That report was used by the PEA team as the basis to describe the proposed action alternative. Table 4 presents a timeline of the priority program activities. Final program details are still being developed.

**Papua New Guinea:** The NGO partnerships described for Alternative 1 in PNG would continue under this alternative. The working relationship with the other organizations -- RIC, RAN, ETC, and WARP -- would also continue. Additional NGO partnerships would be developed, with a goal of 10-15 NGO partners in a consortium by the end of the program.

A summary of the projected portable sawmill statistics and the projected number of NGO partnerships for this alternative appears in Table 3.

**Solomon Islands:** The Solomon Islands program would receive more program resources and attention during the first phases of the program because of the urgency of the threat to remaining forest resources and the likelihood of short-term success there. It would also serve as the regional headquarters and model to test program approaches. As the PNG and Vanuatu programs progress, the specialized approaches proven in the Solomon Islands will be made available for transfer.

Development of the model program in the Solomon Islands would begin with organization of a sawmill owners' and operators' association. The NGO partnerships described for Alternative 1 would also continue under this alternative; although the working relationship between FSP, Soltrust, and ITHL would be expanded. Sawmill associations would be organized on each island and linked by a communication network. Additional NGO partnerships and/or divisions to ITHL would be developed to better address such needs as marketing and related eco-forestry industries. ITHL would start producing sawmills at the rate of 50 per year by dealing directly with New Zealand and Australian parts distributors.

In addition, the program would develop a central facility for secondary processing of lumber for local and export markets, a sawmill owner database, and support for extension and training services. Additional extension officers and eco-foresters would be hired by Soltrust. The program would also develop capabilities for monitoring and assessment, resource management planning, and research.

Table 3 describes the expected sawmill statistics expected with support from the USAID matching grant.

**Vanuatu:** In the near term, existing activities of the Vanuatu program would be expanded, primarily in the areas of planning, extension and training, monitoring, and integration of local management and organizations. Priorities for additional activities focus on effective education and extension, socio-economic assessments, and local secondary processing capabilities.

The VSSP program described for Alternative 1 would continue for at least three years. With additional USAID and FSP funding the planned program would supplement existing activities in program management, training and extension, and product marketing.

The sawmill statistics for Alternatives 1 and 2 in Vanuatu are identical because the VSSP is already in place (Tables 2 and 3).

**Table 2. Numbers of Portable Sawmills and NGO Partners for the Study Area Under Alternative 1 (#69, #86, and #112).**

COUNTRY	PROGRAM YEAR							
	1	2	3	4	5	6	7	8
<b>Sawmills Available:</b>								
PNG	675	775	875	975	1075	1175	1275	1375
SI	48	48	48	48	48	48	48	48
VAN	6	12	18	24	30	30	30	30
TOTALS	729	835	941	1047	1153	1253	1353	1453
-----								
<b>Sawmills Active:</b>								
PNG	337	387	437	585	655	729	804	880
SI	24	22	20	18	16	14	12	10
VAN	6	12	18	24	30	30	30	30
TOTALS	367	421	475	627	801	773	846	920
-----								
<b>Sawmills Inactive:</b>								
PNG	338	388	438	390	420	446	471	495
SI	24	26	28	30	32	34	36	38
VAN	0	0	0	0	0	0	0	0
TOTALS	362	414	466	420	452	480	507	533
-----								
<b>Sawmills Practicing Sustainable Forestry:</b>								
PNG-FSP	4	2	0	2	4	7	11	16
PNG-Others	34	39	44	39	42	45	47	50
Subtotals	38	41	44	41	46	52	58	66
SI-FSP	3	2	1	0	0	0	0	0
SI-Others	13	6	0	0	0	0	0	0
Subtotals	16	8	1	0	0	0	0	0
VAN-FSP	6	12	18	24	30	30	30	30
VAN-Others	0	0	0	0	0	0	0	0
Subtotals	6	12	18	24	30	30	30	30
TOTALS	60	61	63	65	76	82	88	96
-----								
<b>Number of NGO Partners:</b>								
PNG	3	3	3	4	5	6	7	8
SI	3	3	3	3	3	3	3	3
VAN	1	1	1	1	1	1	1	1
TOTALS	7	7	7	8	9	10	11	12

NOTE: PNG = Papua New Guinea, SI = Solomon Islands, VAN = Vanuatu; the Vanuatu program is advised by a committee of NGO and government representatives, which is counted as one partner.

**Table 3. Numbers of Portable Sawmills and NGO Partners for the Study Area Under Alternative 2 (#69, #86, and #112).**

COUNTRY	PROGRAM YEAR							
	1	2	3	4	5	6	7	8
<b>Sawmills Available:</b>								
PNG	675	775	875	975	1075	1175	1275	1375
SI	48	98	148	198	248	298	348	398
VAN	6	12	18	24	30	30	30	30
TOTALS	729	785	1041	1197	1353	1503	1653	1803
-----								
<b>Sawmills Active:</b>								
PNG	405	480	560	643	731	793	867	962
SI	24	59	104	158	199	239	278	318
VAN	6	12	18	24	30	30	30	30
TOTALS	435	551	682	825	960	1062	1175	1310
-----								
<b>Sawmills Inactive:</b>								
PNG	270	295	315	332	344	382	408	413
SI	24	39	44	40	49	59	70	80
VAN	0	0	0	0	0	0	0	0
TOTALS	294	334	359	372	393	431	478	493
-----								
<b>Sawmills Practicing Sustainable Forestry:</b>								
PNG-FSP	4	6	10	18	34	66	130	258
PNG-Others	34	53	67	84	102	127	156	192
Subtotals	38	59	77	102	136	193	286	450
SI-FSP	3	5	9	17	32	64	128	256
SI-Others	13	36	69	109	137	151	136	62
Subtotals	16	41	78	126	169	215	264	318
VAN-FSP	6	12	18	24	30	30	30	30
VAN-Others	0	0	0	0	0	0	0	0
Subtotals	6	12	18	24	30	30	30	30
TOTALS	60	112	163	252	335	438	580	798
-----								
<b>NGO Partners:</b>								
PNG	3	4	5	6	8	10	12	14
SI	3	4	4	4	4	4	4	4
VAN	1	1	1	1	1	1	1	1
TOTALS	7	9	10	11	13	15	17	19

NOTE: PNG = Papua New Guinea, SI = Solomon Islands, VAN = Vanuatu; the Vanuatu program is advised by a committee of NGO and government representatives, which is counted as one partner.

**Table 4. Timeline of Program Activities Under Alternative 2 (#26) (Note: PNG = Papua New Guinea, SI = Solomon Islands, ALL = All countries, SI-1 = Solomon Islands year 1, etc.)**

TASKS (Country Involved)	YEARS							
	1	2	3	4	5	6	7	8
A. Forest management plan development and research aimed at future plan revisions and EAs (ALL)	X							
B. Establish NGO consortium (PNG)	X							
C. Develop training materials and capacities; improve technical extension services (ALL)	X	X	X					
D. Develop sawmill owner associations (ALL)	X	X	X					
E. Develop uses for lesser-known wood (SI)	X							
F. Development of increased sawmill manufacturing and sales (SI-1, PNG-3)	X		X					
G. Work with the private sector (ALL)					X		X	
H. Procure Eco-Timber Certification (ALL)						X		
I. Establish government working relationships (PNG, SI)						X	X	
J. Initiate reforestation projects with local species (SI).							X	
K. Develop new secondary lumber products (ALL)	X	X	X					
L. Data collection and analysis for plan revisions, timber certification protocols, training, etc. (ALL).				X	X			

**Table 4. (Cont.)**

TASKS (Country Involved)	YEARS							
	1	2	3	4	5	6	7	8
M. Land use planning and forest management plan revisions (ALL)						X		
N. Legislative and policy reform (PNG,SI)						X	X	X
O. Increase community planning efforts and integrate other eco-enterprises (ALL)						X	X	X
P. Complete market surveys and develop local markets (ALL)	X	X	X	X	X	X	X	X
Q. Develop management information and communication systems; develop media contacts (ALL)	X	X	X	X	X	X	X	X
R. Monitoring and evaluation (ALL)	X	X	X	X	X	X	X	X

## CHAPTER 4 - AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter addresses the affected environment and environmental consequences of Alternative 1 (No Action) and Alternative 2 (Proposed Action). Each of the following sections represents one of the issues identified in Chapter 2. Distinctions between the conditions and consequences of the host countries are made within the discussions of each issue. More detailed information on each issue is available in the individual specialist reports found in the project record (#82A-E).

### A. SOIL AND WATER RESOURCES

#### A.1. Affected Environment

Impacts on soil and water resources due to timber harvesting are a direct function of the kind and degree of disturbances caused. The major forest management activities that affect soil and water involve: (a) harvesting of trees; (b) removing of trees from the site; (c) regeneration of the residual stand; and (d) improvement of the stand between harvesting rotations. Impacts associated with the portable sawmill technologies and use practices observed in this assessment are generally focused on small remote areas and a few trees at any time. This is due to the portability of the sawmills; they may be dismantled and hand-carried into the forest. In addition, this is due to the absence of erosion and residual stand damage often associated with heavy machinery, and due to the high retention of protective tree cover. Post-harvest forest regeneration was observed as well; many of the communities visited by the PEA team practiced tree seedling collection and replanting in harvest sites.

**Papua New Guinea:** Papua New Guinea (PNG) supports a relatively high proportion of young soils of alluvial or volcanic origin with higher fertility status (#3). There are eight major soil orders within PNG (#83).

There are five major rivers in PNG - the Fly, one of the world's largest, the Sepik, the Purari, the Ramu, and the Markham (#103). High rainfall and steeply sloping topography has resulted in many rivers with large flow volumes and high sediment loads.

**Solomon Islands:** The Solomon Islands are situated at a great geologic junction; immense volcanic forces raised the islands at the collision zone of the Pacific, Solomon, and Australian tectonic plates. The landform map of the Solomon Islands (#83) shows the major landforms and their diversity, including young volcanic areas, karst topography, swamps, beaches and floodplains. Twenty-seven soil groups are recognized in the

Solomon Islands, all generally rich in nitrogen, phosphorus, and organic matter, but relatively poor in magnesium; they are generally well drained and deep (#42).

**Vanuatu:** Vanuatu is situated in a geologically active area on the edge of the Pacific plate. The islands are mostly of volcanic origin, with raised reefs and a few low coral islands. Active volcanoes occur on five islands. Geologic mapping of the islands is complete and a soil capability survey has identified the potentially arable lands. Soil survey maps were not available to the PEA team, but are completed, and display the limits to land use and the susceptibility of the soils to erosion. Erosion problems have caused sedimentation and damage to coral reefs and coastal fisheries.

## **A.2. Environmental Consequences - Alternative 1 (No Action)**

Based on the assumptions presented in Tables 2 and 3 of Chapter 3, the following environmental consequences are expected as a result of Alternative 1.

**Papua New Guinea:** No degradation of soil and water resources was discerned as a result of any of the observed harvesting systems that were following the forest protection measures prescribed for the FSP program. Other portable sawmill logging activities were observed that had disturbed vegetation and soils adjacent to streams; and degradation may result. However, the only direct impacts found were in the Highlands where slopes greater than 30% had been logged and logging slash had been piled in streambeds to aid the skidding of logs. Where trees were harvested on excessive slopes, logs were rolled to a central location or skid trail and then pushed down the slope, causing soil rutting. Erosion will be more severe on steep slopes than on gentle slopes and greater on convex slopes than on concave slopes, assuming all other factors are equal.

The prescribed 50 meter riparian protection zone appears to be more than adequate to protect water resources and to curb the production of non-point source water pollutants. The PEA team found no roads that had been built for access to portable sawmill sites in PNG; however, such access routes were built in the other two countries.

Under Alternative 1, more damage to soil and water resources is likely to occur than under Alternative 2 because of the continuation of current practices and the addition of 75 new portable sawmills each year.

**Solomon Islands:** Under Alternative 1, no impacts on soil and water resource are expected as a result of the existing kinds of portable sawmilling operations. No cases of logging near streams or on steep slopes were observed. Tractors or bulldozers were

used by a few of the sawmill operators to create narrow access ways into forested areas. However, the access ways observed by the PEA team were completely covered with herbaceous vegetation and no erosion or environmental damage was observed (#54:e.g. Nusa Bang, 14 Mar). Training is needed in road construction, as well as the other precautions described for PNG above, to avoid environmental impacts due to road building and tractor use, especially on steeper slopes.

**Vanuatu:** Though the PEA team had no direct experience of portable sawmill operations in Vanuatu, reliable reports suggested there has been no impact on soil and water resources due to any of the six sawmills in operation (#26). All the sawmills were operating on gentle terrain well away from any water source. If the guidelines described above are followed, no impacts are expected under either alternative.

### **A.3. Environmental Consequences - Alternative 2 (Proposed Action)**

Environmental consequences for soil and water resources under Alternative 2 will be similar among the three host countries. Training and environmental awareness activities would be focused on improved forest management, including the measures described above to reduce soil and water resource degradation. Further, because the number and percentage of sawmills following the prescribed forest management guidelines would increase, soil and water resource degradation is expected to decrease. Additional conservation practices such as reforestation and reduction of amounts of land converted to agriculture would improve soil and water resource conditions.

## **B. FOREST VEGETATION**

### **B.1. Affected Environment**

#### **B.1.1. State of Knowledge**

In general, very little published or otherwise reported research exists on Melanesian tropical forest ecology and management (#54:Moad, 3 Mar). In each host country, small groups of individuals, mostly expatriate scientists and government natural resource department contract employees, reported the urgent need for a research program relevant to sustainable forest management and biological diversity conservation, both for large-scale industrial logging and small-scale portable sawmill logging operations. In PNG, an attempt was made recently to initiate a study of forest regeneration, but it was never completed (#54:Howcroft, 24 Feb). A small and growing body of literature on small-scale logging and forest clearing effects on forest regeneration and biological diversity in tropical forests exists, mainly for Latin America and, less so, for Asia. Another body of

relevant literature exists for Queensland, Australia, with potential applications in Melanesia (#54:Port Vila, 18 Mar). Notably, Webb (#3) describes tropical forest regeneration and succession phenomena based upon experience in Queensland and related nutrient and geomorphological studies in PNG and elsewhere in South Asia and the South Pacific.

Inventories or maps of primary vs. other categories of forest were available in none of the host countries. However, national forest inventories are planned and underway by government natural resource agencies in cooperation with the government of Australia (#104; #34: Heads of Forestry Meeting, Country Report).

The forest vegetation of Melanesia is extremely rich; over 2500 tree species are known in PNG. Table 5 lists common commercially valued tree species within the study area.

**Papua New Guinea:** Johns (#4) described twelve primary forest vegetation types in PNG. These forest types are listed below with the associated number of dominant and commercially desirable timber species or genera which might be harvested by portable sawmill operators in PNG (#108):

Mangrove Forest	0
Swamp Forest	6
Mixed Lowland Rainforest	20
Monsoon Forest	10
Mixed Lower Montane Forest	7
Oak Forest	6
Araucaria Forest	2
Mid-Montane Forest	3
Mixed Mid-Montane Forest	0
Nothofagus Forest	2
Upper Montane Forest	0
Sub-alpine Forest	0

Four forest types apparently contain no dominant trees considered commercially desirable, and are therefore unlikely to be affected by logging activities except where accessways cross these forests. Clearly, the Mixed Lowland and Monsoon forest types, and the lower elevation types in general, are the richest types in terms of numbers of dominant timber species or genera valued for exploitation. However, each of the other forest types may become more valuable for timber extraction if future market demand for currently less-desirable species or access increases.

Timber and non-timber forest resources are of great value to both rural and urban populations (See the "Socioeconomics" section below). The PNG Forest Industries Council lists and classifies 135 tree species as desirable or commercial, of which 7 "Group 1" species or genera contribute 40% of commercial volume (#108). In addition to timber uses, rural PNG communities use trees for at

least 51 other products, such as fruits, leaves, clothing, building materials, weapons, poisons, magic potions, and other pharmaceuticals. (Gregersen, Draper, and Elz 1989, cited in #82B). Those uses also reflect the probability of traditional manipulation of natural forest structure by forest inhabitants.

**Solomon Islands:** Schmid and Hansell and Wall (1978 and 1976, respectively, in #42, Table 2) described the following seven primary forest vegetation types in the Solomon Islands:

- Mangrove Forest
- Swamp Forest
- Ultra Basic Rock (Casuarina) Forest
- Calcareous Terrain Formations
- Basalt and Andesite Forests
- Agathis Forests
- Montane Forests

The above classification system is based on observed differences in forest composition and substrate. Dahl (1980, in #33:Pearsall, Solomon Islands, Ecosystem files) identified 12 lowland and montane rainforest types, including a distinct riverine gallery forest. A simplified system of forest classification is used by the Ministry of Natural Resources (#17). A set maps defining very gross vegetation types is included in the project record (#83).

Lowland rainforests comprise about 90% of all forests in the Solomon Islands. At least 12 dominant commercially desirable timber and common canopy species or genera occur in the lowland forests in their climax seral stages (Berwick list in #82E; #108; See Table 5). Another listing of the important tree species is included in the RIC training guide (#87). Presumably, each of the forest types may become more valuable for timber extraction if future market demand for the currently less-desirable species or access increases.

In addition to commercial tree species in the forests, 119 native plant species are valued for food and 143 plant species have medicinal value (#33B). The forest is highly valued by some Solomon Islanders as their natural heritage that links them with their ancestry (#54:Honiara, Sister Paul Francis, 18 Mar). Historical manipulation of forest structure by traditional inhabitants is probable in the Solomon Islands too; manipulation of tree species valued for timber, building material, or food, as well as those disliked due to poisonous properties was reported (#54:Anokelo, 14 Mar).

**Vanuatu:** Paine (1988, in #34: Pearsall, Vanuatu, Ecosystem files) described eight primary forest vegetation types in Vanuatu:

Mangrove Forest  
Swamp Forest  
Coastal Forest  
Lowland Evergreen Forest  
Broad-leaved Deciduous Forest  
Closed Conifer Forest  
Montane Forests  
Cloud forest

This classification system is based primarily on observed differences in forest composition. Dahl (1980, in #34:Pearsall, Vanuatu, Ecosystem files) identified 6 lowland rainforest and 5 swamp forest types. The Lowland Evergreen Forest and the Closed Conifer Forest each contain at least one dominant commercially desirable tree species (#34: Workshop on Prospects for Timber Products of the Pacific Islands, Country Report). Only about two of the 13 tree species recognized as commercially desirable are considered dominant or abundant in the forest types above. Presumably, each of the forest types may become more valuable for timber extraction if future market demand for the currently less-desirable species or access increases.

Most of the literature dealing with forest resources list Vanuatu forests as poor and with little value. While the resources might be poor strictly from an economic standpoint, from the perspective of traditional use, the forests are an integral part of traditional livelihoods (#105). Much of the land is too steep for logging. Commercially exploitable timber exists on about 16 of the islands. The trees are valuable, but smaller, partly because the forest is periodically damaged by cyclones (#26).

Vanuatuan lands have not been classified into functional classes or optimal uses. No forest resource inventory is presently available, but one is expected by the end of 1992 (#107). That forest inventory will provide a powerful tool to planners in the determination of optimal land use and capability. Air photo analysis has estimated that 160,000 hectares of forest may be available for harvesting (#107).

#### **B.1.2. Commercial Timber Extraction in Primary Tropical Forest**

Primary tropical forest, in contrast to secondary and degraded forest categories, exists in each host country. The greatest number of hectares and the greatest proportion of primary forests occur in PNG. The portable sawmill logging operations planned in the FSP program would include commercial activities, both for local and export markets, in primary tropical forest of each country as well as other categories of forest. The lumber produced would also be used for building needs in the home communities of the sawmill operators.

### B.1.3. Deforestation and Reforestation

Deforestation rates are presented below, if known, for each host country. In general, reforestation is not a priority and is not practiced by the large-scale industrial logging operators in any of the host countries. Small-scale efforts to develop tree nurseries and to replant logged areas as well as to establish forest plantations exist in each country, usually without regard to genetic provenance differences and negative effects or replacement of native natural forest composition (e.g. #54: Port Vila, 18 Mar).

**Papua New Guinea:** In 1991, natural forest covered approximately 80% of the land surface of PNG, and has declined at the rate of less than 0.1% per year, one of the lowest in the Asia and Pacific region (#80; Davis et al. 1986 and Green and Day 1989, in #32:Pearsall, PNG, Ecosystem files). However, this rate falsely appears insignificant because the remaining forest area is very large, thereby masking the fact that PNG accounts for a significant amount of the region's total area deforested each year. An estimate of the percent of forest cover in PNG that may be classified "primary forest" was not found.

**Solomon Islands:** In 1991, forest covered approximately 88% of the total land area of the Solomon Islands; however, only 10% of this forest is considered commercially exploitable, presumably by large-scale industrial logging operations (#17). More is probably exploitable by small-scale portable sawmill logging operations. Estimates of the percentage of primary forest cover and the deforestation rate for the Solomon Islands were not found.

Deforestation is occurring over a large number of islands, especially at lower elevations; however, this cannot be assessed accurately because inventory data are poor. Since 1978, forest clearing for cultivation has taken place at a rate of between 6000-8000 hectares per annum. Timber resources are expected to last between 15 and 36 years; however, that time period might be shorter because of the recent acceleration in harvesting and new logging concessions (#42; #26). The shortfall between the amount of forest exploitation and the amount of forest replacement is a major concern. Reforestation is uncommon on customary lands.

In Munda, Western Province, the community developed a nursery and planted teak, malaina (a non-native species), and fruit trees. Most malaina seedlings observed had grown more than 15 meters in 2 years. However, faster-growing indigenous commercial species are preferred (#54:Munda, 15 Mar). In addition, the practice of planting seedlings reportedly demonstrates to community members that the planter has made a commitment to establish a tree, and therefore all community members protect the seedlings, even where a forest has been converted to a garden.

**Vanuatu:** The largest reforestation effort observed in Vanuatu was the 5000 hectares plantation at Santo (#107). The oldest plantations were created in 1975. About 40 species of local and non-native species have been planted throughout the country. Estimates of the percentage of forest cover and the rate of deforestation for Vanuatu were not found.

#### **B.1.4. Silviculture Systems**

Five silviculture systems that utilize portable sawmills are known to occur in the host countries. These systems will be described below in terms of the practices observed by the PEA team or reported by others. The greatest diversity of silviculture systems was identified in PNG. Consequently, these systems are first described below for PNG; subsequent discussions for the other countries refer to PNG's systems.

**Papua New Guinea:** Five primary silviculture systems are practiced in PNG. These systems are identified below using a descriptive name invented by the PEA team:

- a) Selective System with Guidelines
- b) Selective System on Steep Slopes
- c) Selective System with No Guidelines
- d) Single Tree System
- e) Clearcutting

The "**Selective System with Guidelines**" is that silviculture system prescribed by Sasa Zibe of Village Development Trust (VDT) (Refer to Chapter 3). It involves numerous guidelines which are discussed in the FSP plan (#26:35-37). Ten percent of the portable sawmills in PNG presently operate within the guidelines of this or similar systems (#69).

The operations and environmental effects of the Selective System with Guidelines were observed at the Villages of Bau and Sawara on the Morobe coast. Village lands have been allocated into zones for agriculture, forests, and preservation. The zoning system appeared to successfully prevent agricultural activities from moving onto clearings made by timber harvesting or the preservation areas (#54:Bau, 23 Feb). Canopy openings above timber harvest areas subject to this system's guidelines were small and appeared natural when compared to natural windfalls that had occurred in the area. In one case, a single tree had been removed, and the canopy opening above the site was about 7 meters in diameter. Nearby, three trees had been removed, and the canopy opening was about 20 meters in diameter.

According to the VDT foresters who hosted the PEA team, post-harvest tree seedlings, stump sprouts, and residual mature tree numbers were adequate to regenerate pre-harvest forest cover within the prescribed 25 year rotation time frame (#54:Bau, 23

Feb & Nusa Bang, 14 Mar). PEA team observations supported the forester's conclusions. Species that regenerate from stump sprouts, such as rosewood and yellow hardwood, had grown 4 meters tall in nine months. Nursery grown stock or wildlings, seedlings collected from the forest and replanted, had been planted where trees had been felled. In all cases observed, natural seedling and sprout production was abundant and taller than the planted seedlings. During the planning and harvesting stages, fruit trees, canoe trees, and other medicinal plants had been protected. Where trees had been felled, little damage to residual mature trees was found.

The **"Selective System on Steep Ground"** refers to a system used in the Highlands provinces and is a reflection of the region's topography, forest types, and population pressures. According to the PEA team's hosts, about 95% of the land is accessible by roads and only 5% is inaccessible because of steep topography (#54: Mt. Hagen, 3 Mar). The Upper Montane Forest of this region has an appearance different from the forests of other regions. At higher elevations, large diameter trees were fewer, possibly due to a reduced growth rate.

This silviculture system is basically similar to the system described above, but differs in the following ways. The minimum tree diameter for harvesting was reduced from 55 centimeters to 40-44 centimeters. And cutting and skidding occurred on slopes greater than 50%, well above the VDT guidelines. In addition, all portable sawmill activities apparently occurred within approximately 250 meters of an existing road. In all observed cases, the logs were dragged or rolled down steep hillsides to the sawmill. A discussion of the environmental effects on soil and water was presented above in Section A. Further, this accessibility allows the increased use of recently harvested sites for gardens as well as hunting and gathering. Following timber harvest, regeneration of commercial tree species appeared to be poor. Therefore, landowners have been encouraged by the PNG Department of Forests to replant with eucalyptus seedlings. The apparently poor regeneration should be investigated.

The **"Selective System with No Guidelines"** differs from the other selective systems in the following ways. The forests were denser and harvested sites were abundantly covered by seedlings and sprouts. In addition, the minimum diameter of trees harvested was 40-45 cm. There was no restriction on the number of trees harvested per hectare, a process apparently dependent on availability of trees and current market demands. There was also no riparian zone protection observed nor were mitigation measures applied on steeper terrain. Following harvesting, replanting appeared to be uncommon and conversion to agricultural uses was evident. As under the other systems, fruit trees and other traditionally used plants were protected.

The "**Single Tree System**" was observed in eucalyptus and pine plantations in Simbu province. At one site, Provincial foresters were harvesting individual 25-30 year old eucalyptus trees and replanting with another eucalyptus. Such replacement appeared to be successful, and the system is designed to perpetuate a mature forest.

The "**Clearcutting**" practices observed were not compatible with the objectives for sustainable forestry. However, clearcutting might be compatible under appropriate conditions, which should be investigated. The primary danger in the clearcutting method is that cleared land traditionally has been converted to gardens and not maintained as forest. The likelihood of such conversion apparently is dependent on the proximity of the clearing to the associated village.

**Solomon Islands:** Portable sawmill silviculture systems practiced in the Solomon Islands are varied. However, they are best categorized as the "**Selective System without Guidelines**" described for PNG above. The PEA team observed little planning associated with any of the operations, a reflection of the lack of training or planning assistance. There were no apparent restrictions to assure that harvested areas would remain forested and not be converted to gardens. Observations of harvested areas not already converted to gardens found seedlings and sprouts, which, according to the PEA team's hosts, were adequate to assure regeneration of the natural forest cover (#54:Nusa Bang, 16 Mar).

**Vanuatu:** Of the six portable sawmills presently in operation in Vanuatu, one is used solely for salvage and removal of the remaining trees in areas being converted to gardens. The silviculture systems practiced by operators of the other sawmills are best classified as the "**Selection System with Guidelines**" as described for PNG above.

## **B.2. Environmental Consequences**

### **B.2.1. General Discussion**

Under Alternative 1 (No Action) and Alternative 2 (Proposed Action), different proportions of portable sawmill logging operations are expected to follow (either by not joining or dropping out of the program) the sustainable forestry guidelines of the FSP program. Table 2 in Chapter 3 of the PEA reveals that the number of hectares impacted under the alternatives are small in comparison to the total forest available in the host countries (4079 hectares impacted under Alt. 1 vs. 6240 hectares impacted under Alt. 2 by Year 8; total of about 40 million hectares forested lands). In addition, the effects of the alternatives would be similar in magnitude.

Portable sawmill logging operations involve several procedures and management actions by which impacts on forest vegetation, flora and fauna, and biological diversity may occur<sup>1</sup>. Impacts may occur at the accessways created to transport workers to work sites, sawmills to milling sites, logs to milling sites, and lumber from work sites to collection stations. Impacts may also occur at the work sites cleared or damaged in the process of felling trees, trimming and cutting logs, and operating sawmills, and collecting, treating, and storing lumber.

The PEA team expects those operations which follow the sustainable forestry guidelines of the planned program to present the least degree and fewer kinds of negative impacts. However, those guidelines (generally described in Chapter 2, Section F) are based on relatively good, but incomplete and controversial assumptions (e.g. the relationship of disturbance gap size to regeneration). Because so little forest ecology and management research information is available, judgments of specific impacts are mostly not measurable. Scientifically-based monitoring and management-oriented research should be made a critical part of the planned program.

**Deforestation and Reforestation:** When given the choice between a large-scale industrial logging concession and the alternative of a portable sawmill logging system, many landowners have opted for the portable sawmill in each of the countries visited. That choice was preferred because of greater landowner control, village employment, and profit from the management of the landowners's forest resources. Those landowner choices could reduce overall deforestation in each of the countries by reducing large-scale industrial logging. That effect could be small, considering the small number of portable sawmill logging operations expected to be initiated by the program during the planned years of operation. However, the cumulative number of

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<sup>1</sup> Impacts on forest resources may be assessed in terms of the dimensions of the logging disturbance process on the forest landscape, including: (a) selectivity, eg. differential disturbance based upon attributes of the species, community, or seral stage or upon attributes of the disturbance itself; (b) distribution and patchiness, eg. the uniformity and extent in the landscape pattern produced by disturbance selectivity; (c) severity, eg. the degree of mortality produced by the disturbance; (d) frequency, eg. repeated entries into a work site over time to harvest different species as market demand fluctuates vs. a single period of entry followed by a long cycle without entry; and (e) season, which might affect disturbance severity, eg. cyclones, volume of flooding, and erosion, and/or the affected environment, eg. fruiting and seed germination.

hectares of participating landowners's holdings thereby withdrawn from existing or potential large-scale industrial logging concessions could be large. And if those lands so withdrawn block access to other lands, the effects could be compounded.

Negatively, those portable sawmill logging operations which are not included or drop out of the FSP program thereby pose the threat of an increase in deforestation due to such activities as concentrated removal of mature trees, even clearcutting, soil erosion, and other impacts which remove forest, provide access for gardening and fire, and reduce the capacity for natural regeneration of the forest. However, this impact would be concentrated in the relatively small number of hectares (estimated at < 5 hectares per year per sawmill; refer to Appendix D) in which the non-participating sawmills operate. Participating operations would not directly contribute to deforestation as long as program guidelines are followed, e.g. limiting tree harvesting practices and gardening access.

The FSP program does not at present contain plans for forest restoration. This is an area of great potential for both reducing deforestation and increasing the forest resource available for either resource production or conservation.

**Forest Regeneration:** A critical question in assessing the effects of logging activities on natural forest is whether and how the structure and function of mature natural forest regenerates under various management practices as well as under post-harvest environmental conditions. PEA team observations of seedling and sapling abundances were noted under the descriptions of silviculture systems above. However, the potential for long-term regeneration to mature forest could not be determined. Moreover, the nature and effects of natural and anthropogenic disturbances on Melanesian forest structure and function, including disturbance gap effects on regeneration, are largely unknown and disputed among scientists and forest managers. Refer to Ford's Specialist Report (#82C) for a discussion of this management problem.

The most severe negative impacts of the planned FSP program on forest regeneration would occur where the portable sawmill logging operations do not follow program guidelines. Potential and observed practices included felling and skidding over residual trees, and removal of the majority of mature trees, usually in concentrated areas closest to accessways. The principal effects of these practices included varying degrees of damage and possible mortality to residual replacement trees, reduction of seed sources for reproduction, and potential reduction of pollination and/or dispersion functions of wildlife associated with reduction of habitat quality. Repeated entries to the logging sites to harvest additional trees could pose compounded impacts, e.g. increased risk of damage to residual

trees or disturbance of seasonal wildlife activities. In addition, many of the sawmill logging sites visited were, or potentially were, subject to the effects of gardening, including plantings of native and introduced species, selective removal of undesirable species, soil depletion due to repeated gardening, and repeated occurrence of fire due to accident and burning between garden cycles. These phenomena were reported to be primary causes of forest conversion to grassland as well as the expansion of grassland at forest margins (e.g. #54:Zibe, 25 Feb; #60). The above impacts could also be compounded at sites where the forest is fragmented prior to the logging activities, e.g. due to a history of garden clearing, or where the forest type is rare, e.g. narrow coastal strips of Swamp Forest or substrate-dependent forest on serpentine outcrops. The above negative impacts are, and potentially would be, reduced to insignificance where sawmill operators follow the FSP program guidelines.

The planned FSP program, through its technical assistance and support networks, is likely to provide an attractive model for sustainable and profitable forest resource management as observed at Bau, PNG (#54:Bau). Under the leadership of Sasa Zibe and a growing number of his associates in the field, VDT has successfully developed model land use plans, harvesting systems, and cooperative mechanisms to help solve transportation and additional problems. Neighboring Sawara and other communities were following Bau's example, to the extent of changing the community position on alternative forest resource management schemes.

#### **B.2.2. Alternative 1 (No Action)**

**Papua New Guinea:** Under this alternative, the number and percentage of sawmills operating under the FSP program guidance would initially decline. By year eight, 880 total sawmills would be operating, but only 66 would follow the "Selective System with Guidelines" or the planned FSP system. Alternatively, more destructive silviculture systems would probably be substituted.

Alternative 1 would affect the least hectares, but there would be more impact per hectare, e.g. harvest diameter limits would be reduced and more trees would be harvested at greater density. More sawmills would be operating without the planning and land allocation framework provided under the planned system. Therefore more harvest sites would be converted to gardens.

**Solomon Islands:** Under this alternative, training and other essential support would be reduced and the number of operating sawmills would decrease. As the existing sawmills broke down, alternative sources of revenue from the forest would be sought, including sales of timber concessions or conversion of forests to cash crop agriculture. More hectares and greater impact would result.

**Vanuatu:** The PEA team had no direct experience of portable sawmill operations in Vanuatu. However, little significant forest impacts due to portable sawmills is expected (#54:Port Vila, 19 Mar). The most common use of portable sawmills in Vanuatu is for salvage of trees on sites damaged by storms or under conversion to agriculture. These uses do not involve sustaining a natural forest. Only minimal impacts were suggested due to the remainder of the sawmill operations in Vanuatu (#26).

### **B.2.3. Alternative 2 (Proposed Action)**

**Papua New Guinea:** Under the Proposed Action Alternative, about 50% of the active mills would operate under FSP guidance or a similar system. Forest regeneration following harvest and reforestation would be improved or assisted as observed in operations at Bau and Sawara presently guided by the FSP program (#54; 25-26 Feb). Gardening in harvested blocks would decrease as well.

By year 8, half of all forest lands affected by portable sawmill operations would be following the planned program. More sawmills would be operating and more hectares of forest would be affected than under Alternative 1 because harvesting density would decrease under the planned system.

**Solomon Islands:** Under the Proposed Action Alternative, training and other services would increase. Ninety percent of existing sawmills would be operational within two years (#54:ITHC, 17 Mar). By year 8, 300 sawmills would be in operation. And 90% of those sawmills would be under the guidance of FSP. Under the prescribed silviculture system, a larger size limit for harvestable trees and a reduced density of harvest would result in reduced forest impacts. In addition, the likelihood of conversion of harvested sites to gardens or cash crops would be reduced. Also, tree planting and reforestation activities would increase.

**Vanuatu:** FSP has estimated that Vanuatu's carrying capacity for portable sawmills is 30. Forest impacts would be negligible if the sawmills are operated within FSP guidelines.

## **C. FLORA AND FAUNA/BIOLOGICAL DIVERSITY**

This issue represents a combination of environmental concerns defined in Congressional legislation and USAID procedures pertaining to environmental assessment (#27; #31), and at other times referred to as wildlife and nature conservation. For purposes of this PEA, the term "biological diversity" refers generally to that combination and variety of natural elements and processes of the biological environment, including interactions with human occupants, which occurs natively in a specified environmental setting. The term represents the objects of an

expressed political interest in the conservation of nature encompassing more than the traditional focus on "resources" and economically valuable elements such as game animals. Specifically, the concept combines the theoretical ecology concept of diversity with the conservation concept of critical elements of that diversity at all biologically relevant levels of organization, from genes, populations of species, and communities, to ecosystem services and processes.

The affected environment and environmental consequences of the alternative actions are related to those discussed above for the "Forest Vegetation" issue (Section B). Discussions below are supplementary.

### **C.1. Affected Environment**

#### **C.1.1. State of Knowledge**

A relatively larger body of relevant literature exists regarding the composition and distribution of selected groups of flora and fauna of the Melanesian tropics than is available to address the vegetation ecology and management issues discussed previously. However, very little published or otherwise reported research specifically describing the basic ecology and management of Melanesian tropical forest biota or ecosystems was found in this investigation (See e.g. #32-34:Pearsall, bibliographies).

**Papua New Guinea:** Promising efforts to assess biological diversity and conservation needs for each country have begun recently. In PNG, a "Conservation Needs Assessment" (CNA) is being compiled as a cooperative effort of the PNG Department of Environment and Conservation, NGOs, and USAID (#28; #29). When completed, the CNA will provide a data base and assessment of species and ecosystems and their conservation values and status. It will also assess landowner concerns as well as the legal, cultural, and institutional framework for conservation.

**Solomon Islands:** In the Solomon Islands, a Regional Environmental Technical Assistance project produced a "State of the Environment" report which summarized collected information on vegetation, fauna, and marine resources, among other topics relevant to conservation (#42). The project will also produce a "National Environmental Management Strategy" to reflect key environmental issues, including biological diversity conservation. The Australian government is sponsoring a "National Forest Resources Inventory" as well which will provide valuable information on forest composition, distribution, status, local community concerns, and identify and map major ecological domains and biological diversity centers (#104; #42).

**Vanuatu:** In Vanuatu, a "National Conservation Strategy" is being developed in cooperation with the International Union for the

Conservation of Nature and Natural Resources by the Environmental Unit of the Ministry of Lands, Minerals and Fisheries (#91). The report will profile the incomplete knowledge of Vanuatuan biota. Another project of the Environmental Unit is a "Potential Protected Site Assessment" which evaluates the biological diversity, culture, and environmental significance of candidate sites (e.g. #90).

### **C.1.2. Flora and Fauna and Natural Communities**

**Papua New Guinea:** Robbins (1970, in #85) estimated the presence of 11,000 species of vascular plants in PNG, most of which bear affinities to the Asian flora, and many of which have not yet been collected or described. Dahl (1980, in #32:Pearsall, PNG, Ecosystem files) lists 45 habitat types for the New Guinean Province, including both PNG and Indonesia's Irian Jaya.

The New Guinea mammalian fauna bears affinities to Australia rather than Asia, and contains 200 species, including all three sub-classes of mammals: the monotremes, marsupials, and placentals (Menzies 1991 and George 1984, in #85). The avifauna of PNG, at over 700 species, is similar in species richness to Australia whose land mass is over ten times larger. The herpetofauna contains more than 475 species, including 170 lizards and 200 frogs (Whitaker et al. 1982 and Zweifel and Tyler 1982, in #85). Butterfly species number greater than 700, including the world's largest (Parsons 1983, in #85).

The most species rich ecosystem in PNG is the lowland rainforest, and species diversity declines while endemism increases with increasing altitude (Heywood 1987, in #32:Pearsall: PNG, Ecosystem files).

Threatened forest ecosystems include all primary forests, especially lowland forests, including those on serpentine soils (Davis et al. 1986 and Heywood 1987, in #32:Pearsall, PNG, Ecosystem files). Four plant families are listed by the CITES Convention: Cyatheaceae, Cycadaceae, Nepenthaceae, and Orchidaceae.

**Solomon Islands:** Henderson and Hancock (1988, in #42) identified 3,210 species of vascular plants with 1,077 genera and 205 families. If they include unrecorded species they estimate the total will reach over 4,500 species. Whitmore (1969, in #42) found the strongest affinities with the flora of Malesia (the region encompassing PNG, Malaysia, Indonesia, and the Philippines). Dahl (1980, in #33:Pearsall, Solomon Islands, Ecosystem files) lists 31 habitat types for the Solomon Islands Province.

In contrast to the fauna of the Solomon Islands and the flora of PNG, there is little endemism in the flora of the Solomon

Islands; only three endemic genera and no endemic families of plants are reported (#42). However, plant species endemism is thought to exceed that of Vanuatu.

There is no assessment of rare and endangered plants for the Solomon Islands, due to the very limited history of scientific collecting (#42). Threatened forest ecosystems include lowland rainforests, especially those on serpentine soils, limestone forests, and mangrove forests (#33:Pearsall, Solomon Islands, Ecosystem files).

Other than frogs, the mammals are the most poorly known group of vertebrates in the Solomon Islands, and studies of habitat requirements and locations are urgently needed (#42). Native mammals species number 52, with 50% endemics, and represent one of the world's richest bat and rat faunas. Flying foxes are known to be important dispersers of commercial tree species. Twenty-four species are considered rare, vulnerable, endangered, or extinct (Flannery and Parnaby 1991, in #42).

The avifauna are the best studied group among the Solomon Islands vertebrates; however much remains unknown about the ecology and status of many species, including two exploited for the wildlife trade (#42). Most of the avifauna have affinities to New Guinea (#33:Maruia Society). The avifauna includes over 173 species of land birds plus at least another 50 shorebirds or migrants, more than any other Pacific island country (#42). Forty-four percent of the species are endemic. Eighteen species are listed as threatened and five more as near-threatened. Twelve others are suspected to be extinct or endangered, but their status is unknown. Rare bird species number 102.

There are 61 known reptile species, 25 of which are endemic, and 17 frogs, 7 of which are endemic (#42), with affinities, like the plants, to Southeast Asia (#33:A Protected Forests System). Information on the ecology and status of the herpetofauna is so rare that assessment is difficult (#42). Five reptiles appear to be endangered or possibly extinct, while 8 more are rare. Three frogs are thought to be rare and vulnerable. Invertebrates show similarly high species richness, endemism, and vulnerability (#42).

One of the primary threats to biological diversity other than logging and garden clearing is the spread of invasive introduced plants, many of which appear to spread following disturbance of natural forest (#42). However, there is no assessment available of the impacts. Hibberd and Schenk (1991, in #42) reported that the spread of introduced plants such as Mimosa and Broussonetia may interfere with natural forest regeneration. Introduced feral cats, marine toads, and the black rat are known threats through competition, predation, and toxicity.

**Vanuatu:** About 1,000 species of vascular plants have been recorded for Vanuatu, of which 150 are endemic (#91). Dahl (1980, in #34:Pearsall, Vanuatu, Ecosystem files) lists 37 habitat types for the Vanuatuan Province. The Vanuatu islands are little known scientifically, and much work is needed to complete an inventory (#91) and begin additional work on ecology and status.

The Vanuatuan avifauna contains 60 species (#42), including 2 endemic genera and 5 endemic species (#91). There are 22 reptile and amphibian species known, including 4 endemic lizards; 71 butterfly species, including 5 endemics; and 76 land snail species, of which 57 are endemic (#91).

Threatened forest ecosystems include swamp forests and Agathis forests (Dahl 1980, in #34:Pearsall, Vanuatu, Ecosystem files).

### **C.1.3. Populations, Species Interactions, and Genetics**

Little is known about the ecology and status of most groups of Melanesian biota. The prescription of forest management systems to meet conservation objectives requires information about the viability of the populations and structure of sub-populations of critical species as well as available habitat and threats to its loss or degradation. But that information is generally not available; training and support for monitoring and research is needed. Other concerns which cannot be addressed adequately at this time include critical ecological relationships between species, e.g. interspecies linkages for pollination or dispersal.

Another concern is related to the genetic structure of species. Because many species differ genetically within and between population groups, characteristics of individuals in a species may differ geographically in habitat requirements or tolerances. Large-scale reforestation efforts must address genetic provenances among Melanesian tropical forest areas; the distinctions among same-species nursery stock, probably based upon source area and elevation, may affect survival and the ultimate regeneration of the forest. At present, little attention is given to this concern (#54:Port Vila, 18 Mar). Intensive selective logging could cause significant reductions in genetic diversity, especially because of the high species diversity and consequent low density of many species in Melanesian forests. However, the silviculture systems prescribed in the planned program are designed to prevent such consequences.

### **C.1.4. Ecosystem Processes and Services**

The concept of biological diversity also includes the complex systems and processes in which species, including humans, exist and interact. Tropical forests are of great value in provision of ecosystem services, e.g. clean water sources, moderation of

watershed, control of siltation, and production of non-timber resources (#80). Natural landscape patterns are often dependent upon ecosystem process regimes, e.g. cyclone or fire disturbances.

The presence of tropical forest vegetation provides critical influences on the physical and biological environment of tropical ecosystems (#2). These functions include acting as windscreens, reducing temperature extremes, increasing infiltration and deep seepage of water, and moderating stream flow. Much of the fertility of tropical forest systems is above ground, and when the forest is relatively undisturbed, nutrients are very efficiently cycled from forest litterfall which is rapidly decomposed in a microbially active humus layer to shallow feeding roots. When tropical forests are harvested or cleared, soil erosion and loss of replacement seedlings and saplings may occur sufficiently to degrade the site and limit regenerative capacity. The natural disturbances described previously have a similar effect on these tropical forest functions. Critical factors in determining the impact of logging, forest clearing, or other disturbances on forest ecosystem integrity and regenerative capacity are the degrees of severity, homogeneity, and extent of the disturbance relative to undisturbed forest in the local landscape context. Such disturbance effects have received a limited amount of research in Asia and Central America, but research is virtually lacking in the South Pacific (#80; #54:Moad, 3 Mar).

#### **C.1.5. Biological Diversity Conservation Areas**

The FSP sustainable forestry program, as practiced in pilot form in PNG, uses a land use zonation system in its management planning which incorporates a conservation area (#54:Bau). This element of planning was not practiced, but was proposed, for appropriate lands and portable sawmill logging operations in the other countries visited. Each of the host countries has an existing or planned system of parks or other conservation areas reserved for conservation of wildlife or biological diversity (Refer to #32,32,&34:Pearsall, Country files). However, reserves are mostly inoperative or ineffective due to insufficient resources and the difficulty of replacing the subsistence needs or securing the cooperation of the local customary landowners (e.g. #85). Little is known about critical element ecology and status or about areas of conservation significance. In spite of these problems, efforts are underway to assess current conservation needs and to find ways to secure important areas for conservation of biological diversity content as well as the culture and livelihoods of local occupants.

**Papua New Guinea:** Conservation reserves comprise 2.3% of the land area of PNG (#32:Pearsall, PNG, Managed Area files). Sites in four types of managed conservation area systems are listed by

Pearsall (#32:PNG, Managed Area files): Conserved Areas, National Parks and Reserves, Wildlife Management Areas, and Wildlife Sanctuaries. Townley (#85) reviewed forestry operations as well as existing and proposed protection areas in each province. Further, she makes recommendations for the following: priority conservation areas; logging restrictions; opportunities to strengthen existing programs and agency capability to plan land use and monitor impacts; alternatives to landowner income from large-scale industrial logging concessions; and reforestation.

**Solomon Islands:** Managed conservation reserves exist or are planned in four types in the Solomon Islands: Forest Reserves, National Parks, Wildlife Sanctuaries, and Bird Sanctuaries (#33:Pearsall, Solomon Islands, Managed Area files). A Protected Forest System for the Solomon Islands is planned (#33:Maruia Society)

**Vanuatu:** Managed conservation reserves exist or are planned in four types in Vanuatu: Forestry Act sites, Fisheries Act sites, Recreational Reserves, and National Parks (#34:Pearsall, Vanuatu, Managed Area files).

## **C.2. Environmental Consequences**

Please refer to the introductory discussions under the "Forest Vegetation" section above. The following discussions are supplementary.

### **C.2.1. Flora and Fauna and Natural Communities**

Most notably, these island biotas are highly vulnerable to degradation of habitat, interference from introduced invasive species, and eventual extinction due to their small and often narrow habitats and rarity. The planned FSP program and the alternative are unlikely to impact the flora and fauna and natural communities of affected areas because those areas would be so small. Nevertheless, forest management prescriptions should specifically address and avoid any impacts. For example, if habitat for a critical species or community is narrow or fragmented due to natural conditions or previous forest uses, further fragmentation and consequent habitat degradation could occur due to the uniform removal of species critical to that habitat. Uniform removal of a critical species or forest structural element, e.g. bird nesting trees, could degrade that species' habitat as well as the capacity of other species to be pollinated, set fruit, and be dispersed to regenerate. Remnant stands of coastal Mangrove forests and other forest types are threatened in some areas. Uniform removal of a commercial tree species which is itself a critical species could also result if regenerative capacity were degraded. The greatest concern about impacts should be focused on the limited areas affected by portable sawmill logging operations which do not follow the

program guidelines.

### **C.2.2. Ecosystem Processes and Services**

Any activity which alters the existing natural or managed disturbance regime poses the risk of causing the alteration of the forest structure dependent on that disturbance regime. For example, a uniform increase in drier fuels on the forest floor due to logging activities could increase the likelihood of fire spreading into that area. Portable sawmill logging operations which do not follow the program guidelines could negatively impact critical ecosystem processes and services, including those in adjacent biological diversity conservation areas, if they exist or are planned.

### **C.2.3. Biological Diversity Conservation Areas**

Portable sawmill logging operations which do not follow the program guidelines could negatively impact designated or potential biological diversity conservation areas, especially those which are most vulnerable. However, operations which do follow the program guidelines would likely be compatible with conservation objectives. Unfortunately, the locations and characteristics of these areas may not be known at the times of logging project design.

## **D. SOCIOECONOMICS**

This section is based on interviews, observations, a literature review of both published and unpublished documents, and previous personal experience in the South Pacific. The Melanesian countries are rich in culture and natural resources. However, except for one case, the three host countries are assessed below as a group.

### **D.1. Affected Environment**

**Land Tenure:** A common resource feature of Melanesia is the constitutional recognition of traditional land tenure; traditional owners are recognized as the owners of the land's biological resources. Papua New Guinea, the Solomon Islands, and Vanuatu are guaranteed their traditional land tenure by legal and constitutional instruments. Ninety-seven percent of the land in Papua New Guinea is held in traditional ownership, 87% in the Solomon Islands, and 100% in Vanuatu (#103, #98)

Traditionally, a person's right to use land comes from membership in a line, tribe, or clan that is descended from the first people to settle the land. The names and authority of tribes or clans are passed from generation to generation through word of mouth, illustrated by actions or symbols, from elders to youngsters. Institutions such as governments, churches, companies, or

councils do not own land.

Patterns of entitlements within groups vary to some extent across each country and both patriarchal and matriarchal lineages are followed (#54, #113). Today, as in traditional times, the application of land tenure is based on a subtle mixture of individualism and community spirit. Members of different lines, clans and tribes have no rights over other tribal land except through special arrangements such as compensation, marriage, warfare, or gifts.

Ownership extends beyond basic property rights to other rights such as the right to garden, hunt, fish, graze animals, or gather fruits or wood (#60, #54). Often these interests are vested in different groups for agreed periods of time, and different groups or individuals might have different but overlapping entitlements to the same land.

The area of land on which members of one kinship group live and carry out subsistence activities is designated to kinship group, line, or tribe/clan. On this land each nuclear family, and therefore its descendants, has substantial rights within well-defined boundaries. The area is marked by ancestral burial sites, domestic plants, fruit trees and gardens. However, other individuals may use some of the land within the boundaries for cultivation purposes, but only with the consent of traditional owners. In general, each member of a kinship group considers the overall kinship land as his or her land by right of descent from one ancestor of the group.

In patrilineal situations, rights to land and resources are men's affairs. Collective usufructuary<sup>2</sup> rights are historically justified and are traditionally transmitted. Actual usufructuary rights are individually laid down, but in a flexible way. There are no completely individual rights. Frequent conflicts over land, both within and between clans, are causes of disputes.

Basic ownership rights appear to be principally a function of effective possession and control, formerly (and sometimes currently) established by force (#54; #113:USP 1984 & 1987). Historically, effective possession and control of land passed back and forth among different groups, depending on the exigency of tribal wars.

Disputes over the ownership of customary land appear to relate primarily to:

1. Which group had effective possession and control of a

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<sup>2</sup> Usufruct is the temporary right to use something, in this case land, without having full domain over that thing.

piece of land at a given date (the date can in itself be a matter of dispute);

2. The geographic limits or property boundaries; and
3. Who qualifies as a member of the land-owning group, and the effect under customary law of inter-marriage, clan splits, and voluntary in-migration from other groups.

The tribes that constitute Papua New Guinea and the Solomon Islands lack written histories or records, which substantially complicates land dispute resolution. Many landowners in Papua New Guinea are seeking formal registration of their lands for purposes of land security in order to obtain bank loans, as well as to protect themselves from land ownership disputes. The Lands Groups Incorporation Act first registers the landowning group and then registers the lands of that group. This mechanism is appealing to some landowners, although the PEA team observed considerable reluctance among many landowners. Their reluctance is based primarily on mistrust of government and a suspicion that registration serves only as a mechanism for eventual government control over traditional lands. For example, landowners might lose their land if unable to make loan payments after using it for collateral on bank loans, which requires formal registration (#54).

**Land Use:** Over 90% of the people in Papua New Guinea, the Solomon Islands, and Vanuatu live in rural areas and therefore depend primarily on the land and its agricultural potential for their existence. Land is directly linked to their daily economic and social interests. The primary land use is for subsistence production, including shifting cultivation and harvest of numerous natural non-timber products of the forest, such as game, fish, plants (legumes, spices, mushrooms, nuts, medicines, and decorations), shade, water, housing materials, canoes logs, tools, firewood, and ritual items (#54). A substantial and increasing amount of customary land in all three countries is utilized for cash cropping activities. Primary export crops include copra, coffee, cocoa, rubber, oil palm and tea (USP 1987).

An increased need for arable land, due to an increasing population, is leading to changes in cultivation practices and increasing rates of land conversion. Fallow periods are becoming shorter and garden sites are being located farther from family dwellings. This is particularly evident in the Simbu Province of Papua New Guinea where high population density has directly impacted land availability and productivity. Conversion of forest land and changing agricultural practices are evident in all three countries. Typically, sites are cleared and burned, then farmed for 1 to 3 years, and abandoned. Woody regrowth varies from site to site and between primary and secondary

successional species, many of which have important subsistence uses (#54; #45; #55). Many of the formerly forested lands near villages were converted to agriculture and burned repeatedly, which eliminates invading woody species, and are now vegetated with high reeds and grasses and considered unsuitable for any use (#54).

Scarcity of land and resources in some regions of each country, for example the Highlands of PNG, has instilled a land ethic in the populations of these areas (#54). They realize their lands and resources are valuable and require careful management. In addition, there are many existing systems of sustainable management that currently exist within the traditional cultures and customs of the people in these islands (#54; #91; #113; University of the South Pacific 1984). Land represents existence in the Pacific; it is an extension of the individual, encompassing one's physical and social surroundings into a greater being that is inherently woven into their fabric of life. Land also incorporates the past, present, and future genealogical relationships between people and their ecosystems, and also forms the basis for local political organization.

**Social Organization and Distribution of Economic Benefits:**

Overall social organization and its ensuing benefits in the three island nations is directly associated with traditional land ownership (#54). Traditional practices of group cohesion, individual obligation to group norms, and leadership according to the group norms have remained. To individuals the group is the world in which they are both protected and judged. Historians believe that European influences have affected the autonomy between and cohesion within groups in the South Pacific. Local landowners, government officials and available literature offer several explanations. However, the principal effect appears to be new and growing aspirations and expectations, which are thought to be the result of the introduction of a cash economy, European goods and technology, social services, economic infrastructure, Christianity, and modern politics (#54; #60; #104; #115; University of the South Pacific 1984 and 1987).

Social organization, as it relates to clans, communities and/or villages participating in the portable sawmill program, vary within each country, but a similar set of organization models established around portable sawmills were found in all three island nations. The social organizations established as a result of the introduction of the portable sawmill varied according to different objectives. However, all such organizations were based on the traditional participatory decision-making process.

Four models of social organization surrounding portable sawmill ownership and use were observed in all three countries, along with a variety of mechanisms and objectives for economic benefit distribution. The four models are named for the level of

organization upon which the sawmill operation was based: community or village, individual (family, tribe, or clan), government, and church or mission.

The actual capital benefits of owning and using portable sawmills is detailed in Table 6 of Appendix D. The specific mechanisms used to distribute overall benefits are discussed under the following models. Note that some of the lumber produced by local landowners using portable sawmills is used to meet local needs, and may not be sold in markets.

**Community or Village:** Communities and/or villages made up of several clans or tribes have obtained portable sawmills as community development projects. In each situation observed, it is also considered a commercial enterprise. In addition, the community may maintain its traditional community government structure in sawmill management functions, or it may identify and/or elect a program manager from within the village, and establish a separate decision making committee. The manager oversees the entire program, including identification of work crews, work sites, transportation, maintenance, and the use and sale of lumber produced.

Those landowners involved in the program are usually paid wages, and most of those involved in the operation are men. Generally, elder men and boys under the age of 14 are not actively involved in the heavy mill operation. Women may be paid, on a per board basis, to carry boards from the mill site to the transportation point or village. Work crews often are rotated, and in this way every family in the community is provided with an opportunity to participate and earn wages. Labor may be donated also, as was observed in a case when start-up money was unavailable for wages. In another case the community decided that the lumber would be used in a community building project. However, when sawmill operations involve the sale of lumber, laborers are always paid.

The community as a whole decides upon the use of the lumber and money resulting from lumber sale (#54). For example, the community may decide that the timber should be used to build guesthouses, trade stores, schools, community centers or family dwellings. Capital gained from the sale of lumber is directed to a community development fund. These funds are expended on community related projects such as village-owned boats, or establishment of other enterprises. Capital may also be reinvested into the portable sawmill project or saved to achieve future objectives and priorities determined by the community as a whole.

**Individual:** The more common portable sawmill organization is a local enterprise based on family, tribe, or clan units that organize themselves as a legal business entity. Under the PNG Business Groups Incorporation Act, incorporation as a business

group enables a customary group to carry on business or engage in other economic activity. The incorporated group is a unique business organization which is largely regulated by the customary law of the members of the group (#117). These types of groups conduct such commercial activities as processing of lumber produced with a portable sawmill, as well as transport, shops, or the production and processing of cash crops. In PNG, the establishment of this type of operation has led to greater community spirit and a marked reduction in crime.

In the Solomon Islands, everyone owning a portable sawmill for the purpose of selling timber is required to obtain a business license from the Provincial Government. Profits gained from these enterprises are either reinvested in the sawmill business or directed to other community projects such as trade stores.

Portable sawmill business groups use varying types of labor structures (#54). Everyone in the landowning unit may have the opportunity to benefit by working on a crew, with identified rotating work cycles. This arrangement appeared to be successful due primarily to the opportunities for landowning members to have jobs and access to wages, and vested interests in the success of the portable sawmill enterprise. In instances where operations are exclusively to produce profits, only one crew is selected from a landowning group. Another method of labor organization is the use of hired labor from outside the landowning unit, particularly when a clan or tribe is small in number.

**Government:** A unique system of collaboration between the government and landowners was observed in Papua New Guinea. Due to government tree planting programs in the 1960's, roadside villages now have mature trees (*Eucalyptus*, *Pinus patula* and *Pinus carribea*). Although landowners in the valley region are primarily involved in agricultural production, they now have significant forest resources.

The Provincial Forestry Office in Simbu Province owns eight portable sawmills and leases them to landowners for 50 Kina per day (100 Kina/day was charged in 1991). A portable sawmill, along with one operator and two casual laborers trained and paid by the government, is leased to landowners. The lumber produced is either used locally for village construction or sold to local markets (#54).

**Churches or Missions:** Churches and missions, particularly in Papua New Guinea, have organized themselves as representatives of communities and/or group of landowners. These organizations directly purchase logs from landowners and process the lumber with portable sawmills. Lumber is usually sold on the local market, and profits are returned to the landowners through various community development programs.

Portable sawmills in all three countries are either purchased with private or communal capital, bank loans, or donor assistance, or are received as gifts. Acquiring and using a portable sawmill has been the first economic activity of some communities, particularly those more remotely situated. And the use of the sawmills has enabled communities to initiate additional economically based projects.

In a variety of instances in all three countries, those landowners who own portable sawmills do not have access to enough trees for their needs. Rights to cut trees are acquired through agreements with other landowner groups. Agreements are usually verbal and conflicts frequently result when the entire landowning group has not been consulted. These conflicts are usually rectified quickly, and provide valuable lessons about future verbal agreement processes. Written agreements are required in the Solomon Islands by the Provincial Government, although they are not always obtained (#54).

**Women's Roles:** Due to limited field time, it was difficult to obtain adequate information from women in the communities. This was primarily because men serve as the traditional contacts for visitors, and because men were always the leaders of the portable sawmill projects. To date, little attention has been given to the effects of portable sawmill programs on women's lives. The major discussion regarding women has centered around the creation of spin-off projects from the sawmills. The effects of spin-off projects upon women's workloads have not been evaluated.

There are several explanations for the absence of attention paid to women. Few women are included in decision making or given leadership positions such as planners or government extension agents. In general, government policy makers and community leaders ignore the role of women in the overall planning and implementation of programs, which appears to have a strong cultural basis.

The division of labor is based primarily on gender (#54; #103; #60; #66; #94; #2). Women have traditionally played an important role in agriculture and are responsible for planting, weeding, tending of livestock, collection of forest products and garden produce, and fishing; the men traditionally clear land, prepare gardens, hunt, make tools, and construct houses and fences. Women also collect waste wood materials and sawdust at sawmill sites. Scrap lumber is used for building materials and firewood, and sawdust is used for fuel or chicken bedding. In addition, women are responsible for water collection, cooking, care for children and the sick, weaving and basket making, and the sale of produce at markets (#54, Cox, 1991). In rural areas observed by the PEA team, women were often responsible for a greater workload than men. The men seemed to prefer to work in groups, especially when working in the forest. The women were mostly seen working

alone, or with a daughter, daughter-in-law, or other children.

Women also assist in cash cropping activities, which have increased, and apparently caused women's working days to lengthen and be more demanding (#91). New cash crop plantations are established on the most fertile soils nearest the home to increase production and to reduce transport costs. Therefore, subsistence gardens are forced onto land that is less fertile and further away from the home. Women must walk longer distances to reach their workplaces or, to reduce trip frequency, are forced to carry heavier loads in their string bags. This is a serious issue in Vanuatu.

Women generally had an indirect involvement with portable sawmill programs observed (#54). At one site in Papua New Guinea, women established spin-off community projects, e.g a guesthouse, as a result of income generated from the portable sawmill. There is also some direct involvement. In some communities women carry lumber from the sawmill site to a central transport point, and they are usually paid a small amount for each board carried.

Generally, the PEA team observed no negative effects on women's working conditions due to portable sawmill operations. This can be attributed to the availability of laborers within a landowning group. In the cases of labor shortages, outside laborers were hired. The women interviewed felt positive about the portable sawmill program because it improves access to a cash income for the family and community (#54). The women are concerned that they are not consulted about overall land management issues, and that garden sites and productivity are usually compromised as a result of portable sawmills and cash cropping (#60, #59).

Direct ownership of a portable sawmill by women's groups is non-existent, although a proposal was submitted to FSP/SOLTRUST in the Solomon Islands by a women's group on the island of Guadalcanal. The proposal is currently on hold until resources are found to fund the overall program.

## **D.2. Environmental Consequences - Alternatives 1 and 2**

The portable sawmill technology has and will have both positive and negative impacts on the social and economic structures of those communities choosing to participate in the program. However, those impacts associated with past development, cash economies, Christianity, and European influence have already had important effects. Therefore, participation in the Sustainable Forestry Program and the use of portable sawmills will serve as yet another agent of change. If the portable sawmill program is enhanced and strengthened by the inputs of capital to provide market infrastructures, training and extension services, improved transportation, and technology, then levels of social and economic effects will not be entirely predictable.

The primary positive impact of Alternative 2, the proposed action, would be the opportunity to integrate socioeconomic issues into assistance activities and to lessen negative impacts on local participants. Alternative 2 might also assist local participants in the long term preservation of their traditional cultures. Additionally, Alternative 2 would provide an increased awareness of women's roles in communities and integrate them into the operations of the Sustainable Forestry Program. Ultimately this could lead to better understanding of the changing roles of all women and men involved.

The socioeconomic effects of development programs are realized over time, although some effects are more immediately apparent. However, the differences in effects between the current and planned programs are negligible. Therefore, the overall effects of the Sustainable Forestry Program, and the use of the portable sawmill as it exists and as it may exist, are discussed collectively below.

**Land Tenure:** The real effects of the program on land tenure can only be realized over time. In the short term, land tenure issues are not likely to be affected, although conflicts between landowners and between land uses are likely to increase. If the planned program is unsuccessful, it will not provide anticipated social and financial benefits, and this may lead to landowner conflict over resource exploitation. For example, pressures from international timber companies to purchase timber at low prices could become an appealing alternative to landowners dissatisfied with the portable sawmill program. This is already happening in Sawara Village and the Highlands of Papua New Guinea. Additionally, historical and existing land conflicts, particularly in Papua New Guinea and the Solomon Islands, already contribute to the potential for an increase in the frequency and intensity of conflicts (#54:Sawara Village; #54:Holzknecht).

A concern often heard was that changes in land tenure and land transfer law will result in changes in society. A major implication is that land would be seen as merely a factor of production in economic activity. This idea is entirely foreign to traditional Melanesian culture (Ward, 1978).

Customary land use affairs will be altered by any level of participation in the portable sawmill program. Economic benefits provided by the portable sawmill program may lead to access to higher levels of education, greater mobility, reduced delineation between kinship groups as a result of intermarriage, regional immigration, production in the cash economy, rapid increases in population as a result of improved health care, and disruption of traditional methods of birth control. All of the changes instigated by the portable sawmill program will contribute to the shift from a relatively static, traditional society, towards a more fluid, modern society. Concepts of land tenure predicated

on relatively stable, well-defined groups of landowners pursuing subsistence food production on permanent group lands will become less descriptive of a modern Papua New Guinea, Solomon Islands and Vanuatu (#116; Ward, 1978).

Several aspects of the land tenure system may inhibit enhanced productivity of the portable sawmill program and are seriously at odds with the goal of generating income earning opportunities in rural areas. Land disputes, such as those observed in the three study countries, can create an environment of uncertainty which will discourage customary owners and/or occupants of land from investing effort and/or capital in the development of portable sawmill operations. Inability to individuate group interests in customary landholdings may discourage those choosing to seek loan capital to establish a portable sawmill. This is because community owned land cannot be used as security by an individual, particularly to lending institutions (USP, 1984, pp. 11-52).

The Land Groups Incorporation Act may be a vehicle for landowners to obtain more security over their land and resources. A customary landowner may contemplate embarking upon a cash venture if there is less risk of a neighboring clan or tribe asserting a claim to the land (#54:Holzknecht; #54:Inu; #117).

Weaver and Ward of the University of the South Pacific (USP) predict that as land acquires increased economic value as a source of income generation in the money economy, pressures will mount for increased opportunities for acquisition and alienation. Similarly, one can predict that as land assumes increased economic value, and as population growth further increases its scarcity value, the potential for land disputes will increase, reflecting the enhanced values attached to assertions of territorial imperatives. One can also predict that population mobility, reflecting higher levels of education, improved transportation infrastructures, and increased opportunities to participate in the development of the country and/or community, will render composition of land owning groups less stable (Ward 1978; USP 1984; #116).

More direct dealings in customary land, more land disputes, and less stable group structures, in countries with no written history, and no customary land records, are not auspicious if the goal is social and economic stability. These tensions are likely to lead policy makers to institutionalize land policy reform in the South Pacific Islands (Ward 1978; USP 1984; #115).

However, the traditional relationship between Melanesians and their land has been disrupted in the last century by historical events of categorically greater significance than portable sawmills (#54, #115, University of the South Pacific, 1984 and 1987).

**Land Use:** Populations are growing. In Papua New Guinea the annual rate of increase is 2.3%, in the Solomon Islands at 3.5%, and in Vanuatu at 3.0%. Although all three countries have a relatively low ratio of people to land area, the implications of this type of growth will influence space and resource needs for generations to come. Therefore population growth is critical in terms of development of the Sustainable Forestry Program (#54; Vanuatu Scoping; Densley 1974).

Cyclone frequency poses an additional and unpredictable constraint on portable sawmill projects. Vanuatu and the Solomon Islands are particularly vulnerable to damaging storms. Malaria is a great concern in the Solomon Islands, where overall labor productivity in any activity is influenced by the frequency and intensity of malaria outbreaks (#54).

Linking well-being with sustainable resource management is crucial for the success of the project and health of the ecosystems involved. If the local people cannot perceive benefits from the resource management component of the sawmill program, then the sawmill program will increase social alienation. People of Bau village, for example, perceive that the economic gains brought by the portable sawmill contradict the need to conserve forest resources. Although they are attempting to integrate the two, they realize they may need assistance. Understanding these complexities and integrating the objectives, needs, and perceptions of local communities in the planning of sustainable management systems are critical to program success.

Program management that ignores the needs of the local people is likely to result in linking conservation with thwarted dreams. The sawmill program risks being perceived as the cause of the lack of benefits such as health services, housing improvements, churches, and schools. When conservation becomes synonymous with hardship, social impacts may outweigh ecological gains. In the end, frustrated participants are likely to seek different ways of using their resources (#113).

**Social Organization and Distribution of Economic Benefits:** The introduction of a cash economy into the existing subsistence economy has been, and undoubtedly will be, the cause of substantial changes among the lives of people in PNG, Solomon Islands and Vanuatu. These effects are often universal throughout the lesser developed world and impacts can be seen as governments respond to changing needs (USP 1984 & 1987; Densley 1974). A number of changes have already occurred, as shown in the following examples. People are now demanding roads to replace walking and paddling as the means of transportation. People are also demanding new markets for cash producing commodities instead of consuming surplus crops or livestock in traditional festivities. People are replacing traditional gardening lands with economic trees, such as coconuts and cocoa,

as well as cattle. They are buying imported consumer goods over and above the traditional crops and vegetables. They are referring land matters and other injustices to magistrates rather than to the chiefs of kinship groups. Families are going to hospitals in place of using traditional bush medicines. And people are demanding protection from the police instead of from the kinship group.

It is difficult for an outsider to judge whether the above changes are good or bad for the people of the Pacific. However it is certain that the cash economy is seen as far superior to the subsistence economy by these countries. Many communities and landowning groups expressed the need for and appreciation of economic activity beyond cash cropping and sale of surplus staple crops. For others, particularly those in more remote regions (e.g. Bau & Sawara Villages of PNG), the portable sawmill provided their first economic activity. These changes could be viewed constructively as necessary developmental changes, created by growing aspirations and expectations (#54; #116; #45).

During the past decade more South Pacific islanders have come to value cash. This is evidenced in a number of ways: by movement of people from areas of origin to areas of employment in urban centers like Port Moresby, Honiara and Port Vila; by increases in commercial agriculture; by increased numbers of people endeavoring to operate and own retail shops; and by a high value placed on education to enable a person to become professionally qualified for the "well-paid" jobs that are becoming available (#54:Holzknecht; #103; #45; #55).

The portable sawmill program will probably continue to assist in maintaining a local culture and the social structures within it. Communities using the portable sawmill technologies were maintaining their traditional decision making processes, even when negotiating use of resources on neighboring lands (#54). The portable sawmill project has and will continue to provide incentives for people (particularly young adults) to remain in rural areas and participate in the management and collection of benefits of the project.

The concept of communal ownership in the three countries is distinctive in that, historically, members of communal groups have employed themselves to produce food for themselves, rather than employ either themselves or others to produce surpluses to sell outside the groups. As with the advent of cash cropping one can predict that the introduction of portable sawmills will lead to the use of communal resources to generate surpluses. It was observed, particularly in the Solomon Islands, that this has already increased the use of labor from outside the landowning groups. Labor availability may become a constraint, particularly during certain seasons of agricultural productivity and could ultimately affect women's workloads (Cox 1991; Charlton 1984).

As the cash economy evolves changes might occur in the way decisions are made over the use of group resources. At present, site visits and interviews verified that customary law generally assumes a rule of unanimity.

**Women's Roles:** Subsistence production tends to be underestimated in evaluations of the portable sawmill project. Either it is not mentioned in overall program development by NGOs or in observations about the way in which the portable sawmills are being used in communities. When women and men were asked if the use of the portable sawmill interferes with other land uses, the answer is unanimously "no". However, the social and cultural sensitivity of approaching women in these countries makes it difficult to actually obtain verification and a full understanding of their roles.

In many areas throughout the world, subsistence is a full time occupation. Attempts to divert person-hours from subsistence to economically based activities can result in a decline in standards of living, especially where the women have not been able to maintain production while the men were occupied with their portable sawmill business. A decline in nutrition can be the first symptom of the negative effects of cash earning activities. Additionally, social and economic development can increase women's workloads.

Cash can also precipitate new kinds of conflicts within families. The person who controls the money influences a family's standard of living. Whereas men tend to spend money on personal luxuries (beer, cigarettes, transportation to town), women use money for the welfare of the family (food, clothes, petrol, soap, etc.) (Cox 1991; Charlton 1984; #54).

Any level of project development should require an evaluation of the need for reforestation. Reforestation activities have a direct effect upon women, since they usually conduct planting activities, weeding, and care of tree nurseries. With these issues in mind, one should be sensitive to the potential impacts on women in the initial planning stages of the program.

In conclusion, supporting the planned program without integrating women's needs has as much potential for negative impacts as not supporting the program. The roles of women must be completely integrated into the planning, design, implementation and monitoring of the overall project. Cultural constraints will also act as a barrier in integrating women into the project. Failure to understand or allow women's participation will only create further hardships for women that many donor agencies are currently trying to address (Cox, 1991; Charlton, 1984).

**Additional Evaluation:** To address the concerns discussed above, project planners should conduct supplementary socioeconomic

evaluations which more specifically address key issues such as access, decision-making, expenditures, acquisition of sawmills, distribution of benefits, and social impacts at the lowest levels, e.g. families, within the communities affected by sawmill introduction<sup>3</sup>.

## **E. TRAINING AND EXTENSION**

### **E.1. Affected Environment**

#### **E.1.1. Training**

**Papua New Guinea:** Based on visits to portable sawmill sites in the Morobe, Simbu, Western Highlands and East Sepik provinces and visits with national and provincial government agencies, the PEA team found that several agencies offered training on portable sawmill operation. The Timber Institute Training College (TITC) located in Lae offers classes on sawmill operation, saw

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<sup>3</sup> Supplementary socioeconomic studies should address the following questions (personal communication, 11 May 92, Nancy Diamond, social forestry advisor at USAID):

1. Which household members, households, communities, and regions have had access to the portable sawmill program and why? What resources are necessary to purchase or be given a sawmill? How do individuals or groups which have sawmills differ from those who do not?
2. Whose resources are used to keep a sawmill in operation? Who gains or loses access to productive resources as a result of the sawmill?
3. What economic and social benefits have been generated from the use of the sawmill? Are there indirect benefits?
4. Who decides on the distribution of benefits and who receives the benefits? Is decision-making always consensual? Is it only individuals or groups who contribute resources? Are there recipients of benefits who did not contribute resources?
5. What is the potential effect of the new benefits on social organization, social relations, and social distribution of resources (e.g. gender relations, family stability, dispute frequency)?
6. How can the new project provide improved access, benefits, decision-making power, or other compensation to those who are not currently benefiting from the current sawmill program? Should an equity agenda be built into the new program?

doctoring, timber treatment and other technical aspects of processing timber (#54). The Morobe Provincial Government, through its Division of Forests, runs its own technical training program for portable sawmill operators, which is offered at no charge. No coursework in sustained yield management or land use planning is included (#20).

Village Development Trust (VDT) is also offering several training packages. One is the basic three week training class covering sustainable forest management, assembly/preparation of the portable sawmill, tree felling, bucking, positioning logs for milling, operating practices, milling different sized timber, sawmill maintenance, timber treatment, timber storage and product marketing. This training is offered at the developing training center at Bukawa Village, which is a half hour drive from Lae. The training center will have facilities for classrooms and student housing as well as an operating portable sawmill for hands on training. VDT also offers the same course content in a two week extension package in situ when and where requested.

Although the target audience for training is village groups, VDT also conducts training classes for Bulolo Forestry College. Forestry students gain an awareness of the portable sawmill technology and of its integration into village development. VDT has also offered a follow-up training workshop at Bau Village to share information, discuss problems, and begin to formulate solutions. Opportunities for on-the-job training are also facilitated on an individual basis.

All of VDT's training staff are graduates of Bulolo Forestry College. Further training opportunities have been made available to them on a limited basis and a desire was expressed for more training in marketing, timber processing, planning and sustainable forestry practices.

NADEQUIP, a portable sawmill manufacturer, recognizes the need for proper training in both the operation of the mill and sustainable forestry practices. The manufacturer provides a 300 Kina credit on portable sawmill purchases for individuals that participate in VDT's training. Also, PNG bank's are now requiring completion of the training prior to loan approval for sawmill purchases.

In 1990, a review of the portable sawmill training program was conducted by Arentz and Holzknecht (#50). PEA team observations have confirmed that the training program has limited effectiveness. Only half of the portable sawmills sold to date are operating, and throughout all areas visited, there was high operator frustration due to lack of technical expertise in equipment maintenance and repair.

VDT is now in the process of revising the training program to better meet sawmill user needs. In the past the owners and training manuals were written only in English, and instruction was mostly theoretical rather than practical. VDT is updating and improving the manual and training package, including a version in PNG Pidgin. Modules will be added on tree species identification, timber volume calculations, nursery establishment, reforestation, and the business module will be revised. Also, when the new training center is complete, training will include 75% hands-on training and 25% classroom training.

The NADEQUIP credit toward sawmill purchase could not be used for course fees. Portable sawmill owners repeatedly remarked that training was expensive and, in some cases, prohibitive considering the additional costs involved. e.g. transportation costs to Lae as well as room and board for the three week course. When training was brought to provincial centers, trainees still incurred substantial travel and per diem costs. The development of VDT's self-contained training center should keep costs to a minimum.

The training package now offered by VDT covers a substantial amount of material for the three weeks available. Completion of the course can only be expected to enable users to operate and maintain the sawmill at a basic level. Learning more advanced skills in engine repair, saw doctoring, etc. takes additional time and experience. Further skill development is undertaken at the operator's cost and initiative; options include TITC in Lae, vocational schools located throughout the country or on-the-job training opportunities.

Currently, four portable sawmills are operating under VDT's sustainable forestry guidance. VDT prescribes conservation measures and land use planning as outlined by the Rainforest Information Center (RIC) (#26, #62). Most other sawmills visited in PNG were not consciously practicing conservation measures or had not delineated land use areas, and were operated strictly as a business to make the most profit in the shortest amount of time. Those businesses usually planned to expand to larger more efficient sawmills, to improve transportation by using tractors and skidders, and to build access roads to the timber.

The PEA team also found that a small number of sawmills were practicing a form of sustainable forest management without assistance of VDT or other NGOs. However, most communities, whether or not they were using portable sawmills, need to become informed and educated as resource owners about conservation practices, land use planning, and sustainable forestry. With such skills, they will be able to make informed choices on how best to develop and manage their resources.

The PEA team identified the need for training in the following areas: (a) basic sawmill operation and preventive maintenance; (b) harvesting techniques appropriate to different species; (c) wood utilization; (d) saw sharpening; (e) lumber stacking and drying; (f) chemical treatments; (g) marketing; (h) business management; and (i) land use planning.

**Solomon Islands:** FSP's Solomon Islands program and the two indigenous NGOs, SOLTRUST and ITHL work in close partnership to promote their Eco-Forestry program. SOLTRUST provides training and extension services in sawmill operation and forest management.

Their training package covers basic operation and maintenance of portable sawmills, tree felling, bookkeeping, sustainable forest management, land use planning, lumber treatment, and marketing (#54, #87). Training is provided to sawmill owners at their communities upon request at a cost of SI\$2000. The fee covers travel costs for the training staff, training materials, and supplies. The sawmill owner provides housing and meals for the trainers.

In the past, training for basic sawmill operation has been very limited in the Solomon Islands. Of the sawmill sites visited, owners reported they had participated in training lasting between 1 day and 1 week, and many operators did not own sawmill manuals. Consequently, when sawmill engines need servicing, they must be shipped to Honiara. Because shipping and repair costs are high, the sawmill owners are often delayed in raising funds to pay the mechanic in Honiara, who will not return repaired engines until payments are received. This problem has caused increased interest among sawmill owners to receive more training in engine maintenance and repair; this training would give them more independence and control in operating their sawmills.

Other training needs were also identified: saw doctoring; improvement of lumber quality (necessary for export markets); small business management; and marketing. FSP has also identified training needs at the village level and the trainer level in the following skills: land use planning; service program development; sustainable forest management; legal awareness; timber grading; lumber seasoning; export management; reforestation; and safety.

Three of the 25 active sawmill operators in the country participate in the Eco-Forestry Program and have received training on land use planning and sustainable forest management (#112). The other 22 sawmill operators have not received the training in sustainable forest management, and practice a variety of timber selection and management methods.

SOLTRUST has entered into a training agreement with one village. It is a new initiative for comprehensive training in small scale timber operations as well as marketing (#87, #101). Other training opportunities include: a two-week course in small engine repair at the College of Higher Education, and a center for chainsaw milling offered by an entrepreneur in Honiara.

**Vanuatu:** The Vanuatu Small-scale Sawmill Project (VSSP) proposal indicates that training, technical assistance, and education are critically needed to increase the direct participation in forest resource management by landowners (#86). The VSSP proposal outlines needs in training, extension, and education directed at both traditional landowners and FSP training staff. Education has already begun; portable sawmill demonstrations have been held at villages on all islands to acquaint landowners and businessmen with the technologies for developing their forests in an environmentally sound way. Training is currently offered in sawmill operation and maintenance and sustainable forest management practices.

FSP/Vanuatu now has 6 operating portable sawmills in the VSSP. The project plans to hire additional staff and to provide training for them in small-scale sawmill technology, rural sawmill business management, and sustainable forestry. The training staff from PNG will help to develop a complete training package for sawmill owners. Individualized training and follow-up support will also be offered to sawmill purchasers. In this way, local capabilities will be improved to sustain the training and back-up support that the industry will need to grow and develop.

#### **E.1.2. Extension**

**Papua New Guinea:** The sale of portable sawmills is not under control of the Division of Forests (DoF), but, when problems arise, assistance is requested from the DoF. The DoF believes further training and field support is needed to keep sawmills operating at the rural village level, which is currently a role fulfilled by provincial foresters. In addition, existing legislation requires that any commercial sawmill be registered, but this is currently not enforced. And the DoF does not have the financial or staff resources to monitor and supply feedback on rural village sawmilling activities and for more effective government management of portable sawmill operations (#76, #41). Although the official role of DoF includes both administration of large scale logging projects and rural extension, the lack of funding and staff have prohibited them from establishing active extension programs. The only proactive extension program found by the PEA team was in the Simbu Province where high populations compete for a limited amount of arable land in very rugged steep topography.

Presently there is limited cooperation between NGOs and Provincial Forestry Offices. Both hold the view that the development needs of communities cannot be met by DoF. However, the opportunity for cooperation exists because the Provincial Forestry Offices have the technical expertise to inform and educate the community landowners.

**Solomon Islands:** In an effort to facilitate better forest management, the Division of Forests in the Ministry of Natural Resources is conducting a three-year national forest resource inventory (#104). The inventory includes both timber and non-timber values, including ecological, environmental and sociological values, each of which would be considered in making specific land use prescriptions. Because of SOLTRUST's close working relationship with the Division of Forests, there is an opportunity to coordinate with the Division and use the inventory's prescriptions to refine the eco-forestry guidelines and extend the information to the village level when developing land use plans. Other NGOs in the country are currently operating extension programs with which partnerships are possible.

**Vanuatu:** The Department of Forests (DoF) does not have the capacity to conduct awareness programs regarding the negative effects of logging as well as alternative systems. Also little government extension support exists to assist local small-scale forest industries. However FSP is in a management partnership with the DoF that will facilitate sharing of resources, expertise and infrastructure.

## **E.2. Environmental Consequences - Alternative 1 (No Action)**

**Papua New Guinea:** If USAID does not support the FSP sustainable forestry program, current and future training programs would be affected. The new training center would close and this low cost alternative for sawmill operators would no longer be available until additional funding sources could be developed in 2 to 3 years. VDT would most likely offer courses at other facilities as they have in the past with TITC or UniTech, but this would increase the costs to sawmill operators. Other agencies such as TITC and the Morobe Provincial government would continue offering courses on portable sawmill operation and maintenance, but the sustainable forestry and land use planning components would not be included.

The present high levels of frustration among sawmill owners about lack of training or expertise on sawmill repair would continue. As more sawmills are sold without adequate training support, the number of frustrated operators would increase.

VDT is continuing to revise and improve its training manual to better suit the needs of users. Constant monitoring and revising

of the manual would likely decline for several years until new funding for the program could be developed. Follow-up training would be discontinued until supported by adequate funding later.

With limited resources, the opportunity for cooperation with the Provincial Forestry Offices would still exist but would be more difficult to achieve. Fewer landowners would be informed on forest policy issues, sustainable forest management, and land use planning. Opportunities for working with TITC, Unitech, and other NGOs to develop more advanced training courses would not be realized. The training program would continue to be directed towards basic understanding of mill operation and maintenance, but it would lose its present momentum.

**Solomon Islands:** The consequences of Alternative 1 in the Solomon Islands would be similar to that in Papua New Guinea. Without funds, key training staff would be lost and owners of the sawmills would not receive integrated training by the third year; however, the training opportunities from other sources would still be available (#112). With inadequate training, there would be more frustrated owners and the number of inactive mills would increase. Opportunities for partnerships with the Division of Forests and other existing NGOs would be difficult to pursue.

**Vanuatu:** The funding requested from USAID would be used to strengthen and support the above described training components of the Vanuatu project. If USAID does not fund this project, the training components would remain at present levels until such a time that additional funding from other sources could be found.

### **E.3. Environmental Consequences - Alternative 2 (Proposed Action)**

**Papua New Guinea:** With funding support from USAID, the critical training component of the sustainable forestry project would continue to develop and improve. The new VDT training center would remain open to provide low cost operator training integrated with sustainable forest management and land use planning.

The training manual would continue to be revised and improved to meet the needs of the users. Through training evaluations and open dialogue with the users, the effectiveness of the training could be constantly monitored. Through village extension services, the changing needs of the users could also be monitored so that the training could be revised and improved. Training capacities would also be improved through the hiring of additional staff.

With the improved training aimed at the needs of sawmill users, the level of frustration would decrease. As more mills are sold with properly trained operators, the number of active

mills operating would increase (See Table 3, Chapter 3).

Opportunities for developing more advanced training could be pursued with a number of existing organizations. Additionally, opportunities for cooperating with Provincial Forestry Offices could be pursued to share staff support, vehicles, and office facilities.

**Solomon Islands:** With funding support from USAID, training would be given a strong emphasis in the Solomon Islands program. Increased training staff and training programs planned for sawmill operations, reforestation projects, land use planning and management, legal awareness, and extension support would be added to the program. By the end of year 3, 100% of the sawmills would be active in the eco-forestry program (#112). Partnership opportunities with the Division of Forests and other existing NGOs could be pursued to strengthen extension and follow-up services.

**Vanuatu:** With USAID funds for this project, the training components would be increased and improved, which would result in more portable sawmill operators participating in the program and more landowners using the technology in an environmentally sound way to develop and manage their resources.

## **F. WOOD PRODUCTION AND PRODUCT MARKETING**

### **F.1. Affected Environment**

**General Program:** The portable sawmill program in PNG and the Solomon Islands is currently not well organized or conducted, primarily due to lack of sufficient funding. In Vanuatu, a 5 year program already exists and was funded by the European Community (#86). The Vanuatu Small-scale Sawmill Program (VSSP) is monitored and managed by a committee of government and non-government people. Although Vanuatu's program is well organized, coordination of the program between countries has been poor, which has caused unneeded duplication of effort and loss of project management efficiency. Presently, seven NGO partners are involved in the program (See Table 2, Chapter 3).

**Sawmill Availability:** NADEQUIP (Lae, PNG) currently manufactures about 75 new sawmills per year and is the only active manufacturer within the study area. Both SPATF (Port Moresby, PNG) and ITHL (Honiara, Solomon Islands) have manufacturing plants that could produce 50 and 25 mills per year, respectively (#69, #86, #112). Vanuatu is currently importing sawmills from other countries and has not as yet identified a manufacturing infrastructure.

Presently, PNG, the Solomon Islands, and Vanuatu have 600, 48, and 6 portable sawmills, respectively (see Table 2, Chapter 3).

Of the 654 sawmills in the study area, only 13 could be considered to be under an FSP coordinated sustainable forestry program. Another 50 sawmills are probably present in the study area; those sawmills are not involved in the present program, but are implementing some form of sustainable forestry practices.

In PNG and the Solomon Islands, only about 50% of the mills are presently active (#69, #112). Some mills are shut down as a matter of owner preference, but most are shut down because of the lack of training, lack of spare parts and/or lack of sustainable product markets (See Table 2, chapter 3). The mills in Vanuatu do not work all the time, but all can be considered presently operable.

**Sawmill Operation and Access:** The operation of the sawmills or the sawing of the wood is straight forward and is adequately covered in available training. However, sawmill maintenance and repair training is seriously lacking everywhere (See Section E above). It is essential that each sawmill crew have at least one, and preferably several, individuals trained in all aspects of the mechanics of the equipment (engine, sawblade, chainsaws, etc.) (#82D).

Based on the literature (Refer to Appendix C) and PEA team observations, the recovery (percentage in volume of lumber produced from logs by a mill) of the "Wokabout Somil" is as efficient as one could expect with that type of equipment (#82D). Reported recovery is in the vicinity of 40-50%, which nearly approximates the recovery rates of larger stationary sawmills (#82D). Kerf size (width of blade) is 0.8 centimeters (5/16 inch), which is large, but cannot be reduced because of the typically harsh operating conditions to which the sawmills are exposed. The PEA team observed sawing accuracy on field trips; it seems to be as good as one could obtain with this type of sawmill and certainly is acceptable for both domestic and export markets (#54, #82D).

The literature and PEA team field observations indicate that the maximum distance that anyone would carry the portable sawmill and resultant lumber is about 5 kilometers (#82D). Portable sawmill operation beyond that distance would require that a road be built or that some mechanical means of ingress or egress be used, which undermines the no-road principle behind the planned portable sawmill program.

Presently, portable sawmills are impacting 1,655 hectares per year with only 426 hectares per year (25%) impacted from sustainable forestry management practices (Appendix D).

**Value-added Processing:** An ever increasing interest in development of value-added processing at centrally located collection facilities was evident throughout the study area. For

example, the East Sepik Provincial government has been working on a proposal to centralize value-added processing and marketing (#72). Another example was observed in the Highland Province of PNG (#54). Portable sawmill lumber was hauled from the forest to a centralized location. Sanding and planing were being utilized to increase the marketability and use of sawn lumber products in the local area (#54, Personal communication - Jennifer Grant).

Very little if any timber produced by portable sawmills is treated (#54, #82D). The water-diffusible treatments (boron compounds) that have been used are very effective if the lumber is treated and used as specified. These treatments are also as humanly and environmentally safe as any preservative available if used as labels direct. The team did not observe any chemical dumping on the ground, but it probably happens occasionally, which would cause additional environmental harm.

Both good and bad drying of lumber from portable sawmills are practiced in the study area (#82D). Most of the lumber drying utilizes simple air-drying techniques that work, but require careful stacking, stickering, and ventilation, which was not commonly observed on PEA team field trips. Kiln-drying facilities for use by portable sawmill owners are presently not available, but several people interviewed by the PEA team showed interest in developing kiln-drying capabilities (#54).

Another way to add value to lumber is to market it as a "certified ecological forest product". For example, the Institute of Sustainable Forestry Board of Directors has developed "Ten Elements of Sustainability" that need to be met before lumber would qualify for a higher market price as an eco-timber product (#46). To qualify for eco-timber marketing one must go through a lengthy process of certification, which includes submission of a forest management plan (#46).

**Marketing:** PNG data indicate there are sufficient markets for lumber from portable sawmills, including local and national markets and export markets (#82D). For example in 1990, forest-based exports contributed 12% of PNG's total export earnings, amounting to some 83 million Kina (#64). Despite possessing such massive forest resources, PNG still imports timber products from other countries; in 1986 imports of such products were worth 18 million Kina (#64). Similar markets exist for the Solomon Islands and Vanuatu. For example, since independence in 1980, the Vanuatu government has established 25 local supply plantations throughout the country, primarily in an attempt to meet local demand (#34).

The Highlands of PNG present a marketing situation that differs from the coastal areas which are accessible by water. The Highlands comprise five Provinces connected to each other and the major port cities of Lae and Madang by a poorly serviced and

maintained one-lane road. Coastal access difficulties combined with very large Highland populations have created very strong local markets. Virtually all lumber processed by portable sawmills in the Highlands is used locally (#54, Personal communication - Jennifer Grant). Exporting timber processed in the highlands is therefore not practical.

Both PNG and the Solomon Islands have marketed lumber for export through the Ecological Trading Company (ETC) (#54, #69, #112). That marketing effort has not been as successful as was anticipated because of lack of a sustained supply of lumber for export. In addition, the quality of the material didn't always meet purchaser specifications. ETC's payment methods slowed local cash flows, and the world-wide recession has reduced demand (#54). However, ETC should still be considered as a viable market possibility. Success will be a matter of accessing the markets, which requires providing a quality product (i.e., meets customer specifications) in a sustainable manner (guaranteed delivery) at a competitive price (#82D). Vanuatu has only been supplying lumber for local use and has yet to develop a consistent exportable supply of materials or a viable marketing structure (#54:Port Vila, 18 Mar).

Currently, little training is being provided to assist sawmill owners in understanding all the elements of marketing (See Section E). Training has provided a focus only on the business management side of marketing (i.e., invoicing, delivery, quotations, etc.) and not on market development (#48, #50).

**Wood Production and Income:** Production of forest products has shown a general increase over the past years with a trend towards increased local processing (#34B). The process record (Appendix C) contains additional information on commercial lumber production in each country (e.g., #34B, pages 8-10).

Total wood production from the areas harvested by portable sawmills is 81,648 cubic meters per year, approximately 15,264 cubic meters (18%) of which is produced by sustainable forestry operations (See Table 6, Appendix D). Present gross income from portable sawmill operations in the region is estimated at US\$18.7 million (See Table 1, Chapter 2). The net annual profits from portable sawmill lumber production for all markets within the study area were estimated at US\$1,644,480, approximately US\$305,280 of which was earned from sustainable forestry operations (See Table 6, Appendix D).

## **F.2. Environmental Consequences - Alternative 1 (No Action)**

**General Program:** Without adequate funding and management oversight, the portable sawmill program in PNG and the Solomon Islands would continue to struggle. In 1 to 3 years, programs in PNG and the Solomon Islands would essentially shut down while the

energy of existing program managers is expended to obtain new funding, which would require at least a two year effort before restarting the program. The Vanuatu program is funded for at least another three years from another source and will continue to be successful. Overall program coordination within the region would continue to detract from overall project management efficiency. Despite this, NGO partnerships within the region would increase from 7 to 12 (See Table 2, Chapter 3).

**Sawmill Availability:** NADEQUIP (Lae, PNG) would continue to manufacture about 75 new portable sawmills per year. SPATF would probably start manufacturing new sawmills in year 1 at a rate of 25 per year. ITHL could not start manufacturing without additional program assistance. Vanuatu would continue to import needed sawmills until the intended program capacity of 30 sawmills is reached by year 5. By year 8, over 1450 sawmills would be available within the entire study area (See Table 2, Chapter 3). At year 8, PNG, the Solomon Islands, and Vanuatu would have 1375, 48 and 30 sawmills available, respectively. The number of sawmills in the region connected to an FSP sustainable forestry program would increase from 13 to 46. Additionally other sawmills practicing sustainable forestry would increase slightly (See Table 2, Chapter 3). The number of inactive sawmills would decrease by 13% in the next 8 years.

**Sawmill Operation and Access:** Logically, the operation of the sawmill would improve as sawmill operators gain more self-guided hands-on experience through sawmill operation. This type of learning is not as effective as more formal training or assisted hands on training. Individual operators would be more frustrated with the lack of training in such skills as sawmill operation and maintenance, and sawmill recovery rates wouldn't improve much.

Access to forest cutting areas will continue to be a problem where no road system is in place. Available cutting areas farther away than 3-5 kilometers from the villages will tend to be under-harvested with respect to the mitigation described in Chapter 2, Section F. Cutting units closer to villages will tend to be over-harvested. By the 8th year, portable sawmills would impact 4079 hectares per year, a very insignificant amount relative to the total forest available for harvest in the region.

**Value-added Processing:** Localized efforts to continue development of centralized processing stations will gradually incorporate more and more value-added processing (See the scoping reports for the Highlands, #54). Those efforts will more than likely be independent of the current FSP program. Lumber treatments would remain the exception rather than the rule, and the ability to market portable sawmill lumber would not be as easy because of the constrained uses for which untreated lumber qualifies. Air-drying practices would probably remain the rule also. Stacking, stickering and ventilation would continue to be

a problem that reduces the lumber's final market value.

**Marketing:** Export marketing through ETC would continue to be a problem because of the lack of a sustainable supply of lumber for sale, the inconsistent product specifications, and the cash flow problems associated with ETC's present pay structure. Certification of sustainable forestry outputs would be difficult if not impossible, particularly because of the lack of forest management plans.

**Wood Production and Income:** More sawmills would be available and overall portable sawmill production and landowner incomes would increase. Wood production would increase from the present 81,648 cubic meters per year to 200,160 cubic meters per year. Gross incomes generated would increase from US\$18.7 to 46.0 million per year. Lumber profits derived from portable sawmills in the region would increase from US\$1.64 million to 4.13 million.

### **F.3. Environmental Consequences - Alternative 2 (Proposed Action)**

**General Program:** The portable sawmill program in the three country region would be funded by an FSP/USAID matching grant. The largest portion of the grant money is slated for expenditure in PNG and the Solomon Islands (#26). Some funding would be allocated to Vanuatu for program management and training support. Overall program coordination within the three country region would improve through establishment of a regional coordinator for the program. NGO partnerships within the region would increase from 7 to 19.

**Sawmill Availability:** Additional sawmill manufacturing would be initiated by ITHL (Solomon Islands) at the rate of 50 sawmills per year. Total sawmill production would be 175 sawmills per year within the region. Production from NADEQUIP (75 sawmills) and SPATF (25 sawmills) would continue as in Alternative 1.

In year 8, PNG, the Solomon Islands, and Vanuatu would have 1375, 398 and 30 sawmills available, respectively. The number of sawmills in the region connected to the sustainable forestry program would increase from 13 to 544. Successful implementation of this program would also set an example that could indirectly convince sawmill owners not participating in the program to practice sustainable forestry (See Tables 2 and 3, Chapter 3). The number of inactive sawmills would decrease at the same rate (13%) as under Alternative 1, but would account for only 28% of the active sawmills, as opposed to 37% in Alternative 1.

**Sawmill Operation and Access:** Improved extension and training capacities would improve sawmill operation and maintenance (See Section E). Landowners would be able to seek help through local sawmill associations. Sawmill efficiency and recovery rates

would improve slightly (from 40-45% to 50%) (personal communication with Dave Schumann). Better utilization of wood slash from the harvest and milling operations would occur.

Access to forest cutting units would continue to be a problem. The proposed action program doesn't address the problems with access to cutting units farther away than 3-5 kilometers. Units within 1-3 kilometers of villages would still tend to be over-harvested, while units farther away than 3-5 kilometers would tend to be under-harvested relative to the mitigation described in Chapter 2, Section F. By year 8, portable sawmills would impact 9065 hectares per year, still a very insignificant amount relative to the millions of hectares of forest land available in the study area.

**Value-added Processing:** Lumber treatments would be more common as small-scale value-added processing is added to the sustainable forestry program. Broader use of existing lumber would be accomplished by consistent value-added processing such as sanding (#82D). New markets for lumber from lesser-used species would be developed. Better stacking and ventilation procedures would be taught.

**Marketing:** Marketing surveys would be completed in the early years of the project. The training and extension work would improve consistent grading of lumber and give landowners a better ability to meet customer product specifications. Established sawmill associations would assist landowners in marketing and coordinate a consistent level of production to assure stable market supplies.

**Wood Production and Income:** More sawmills would be available and overall portable sawmill lumber production and landowner incomes would increase. Production would be increased by 270% over that occurring now. Income generated by the increased production would increase by 144%.

By year 8, total production would increase from the present 66,384 cubic meters per year to 328,762 cubic meters per year. Annual gross incomes generated would increase from US\$22.4 to 74.9 million. Lumber profits derived from portable sawmills would increase from US\$1.95 to 6.58 million.

**Table 5. List of Commonly Harvested Tree Species within the Study Area (Sources: PNG #1, Solomon Islands #42, Vanuatu #107).**

<b>COMMON NAME</b>	<b>SCIENTIFIC NAME</b>	<b>PNG</b>	<b>SI</b>	<b>VAN</b>
Water Gum (Nacavika)	<i>Syzigium</i> spp.	X	X	X
Masawa	<i>Anisoptera theraflora</i>	X	X	
Yar - Casuarina	<i>Casuarina equisetifolia</i>	X	X	
Pencil Cedar	<i>Paloquin</i> spp.	X	X	
Talis	<i>Terminalia complanata</i>	X	X	
Walnut (Nakatambol)	<i>Dracontomelon emangiferum</i>	X		X
Kwila (Natora)	<i>Intsia bijuga</i>	X		X
Taun	<i>Poinetia pinnata</i>	X		X
Rosewood (Bluewater)	<i>Pterocarpus indicus</i>	X		X
Swamp Talis (Natapoa)	<i>Terminalia catappa</i>	X		X
Whitewood	<i>Eudosperimum medullosum</i>		X	X
Klinki Pine	<i>Agathis alba</i>	X		
Milky Pine	<i>Alstonia</i> spp.	X		
Hoop Pine	<i>Araucaria cunningham</i>	X		
Burckella	<i>Burckella obovata</i>	X		
Cinnamon	<i>Cinnamomum</i> spp.	X		
Cryptocarya	<i>Cryptocarya</i> spp.	X		
Wau Beech	<i>Elmerrilla papuana</i>	X		
White Gum	<i>Eucalyptus alba</i>	X		
Euodia	<i>Euodia elleryana</i>	X		
Ficus	<i>Ficus</i> spp.	X		
Canoe tree	<i>Gnelina molokaua</i>	X		
Hernandia	<i>Hernandia minor</i>	X		
Manjo Tree	<i>Mangifera minor</i>	X		
Yellow Hardwood	<i>Neonauclea acuminata</i>	X		
Erima	<i>Octomeles sumatrana</i>	X		
Planconia	<i>Planchonia papuana</i>	X		
Calophyllum	<i>Calophyllum kajewskii</i>		X	
Gwarogwaro	<i>Calophyllum vitiense</i>		X	
Magera	<i>Camptosperma</i> spp.		X	
Kapuchu	<i>Dillenia</i> spp.		X	
Milo	<i>Elaeocarpus</i> spp.		X	
Arakoko	<i>Gmelina moluccana</i>		X	
Aisiksiki	<i>Maranthes corymbosa</i>		X	
Merbatu	<i>Parinari</i> spp.		X	
Dawa	<i>Pometia</i> spp.		X	
Beabea	<i>Schizomeria serrata</i>		X	
Kako	<i>Terminalia calamansanai</i>		X	
Vitex	<i>Vitex</i> spp.		X	
Kauri	<i>Agathis macrophylla</i>			X
Milktree	<i>Antiaris toxicaria</i>			X
Black Bean	<i>Castanospermum australe</i>			X
(Tamanu)	<i>Calophyllum neo-ebudicum</i>			X
Stinkwood	<i>Dysoxylum amooroides</i>			X
Namalaus	<i>Garuga floribunda</i>			X

## APPENDIX A. LIST OF PREPARERS

### Ronald Senn (Team Leader)

BS Forest Watershed Management, Univ. of Arizona  
MS Range Watershed Management, Univ. of Arizona

Presently a land management planning specialist with the  
USDA Forest Service, Region 3 Office, Albuquerque, New  
Mexico, USA

Contribution: Team leadership; authorship of Chapters 2, 3,  
5, Section F of Chapter 4, and Appendices B and D;  
documentation coordination; record keeping; process  
facilitation; and resource integration

### Lawrence D. Ford

BA Natural History, Univ. of California  
BA Biology, Univ. of California  
MS Range Management, Univ. of California  
PhD Wildland Resource Science, Univ. of California

Presently an international forestry advisor as a AAAS  
Science and Diplomacy Fellow for USAID, Washington D.C., USA

Contribution: Final report editing; authorship of Sections  
B and C of Chapter 4 and Specialist Report #82C; forest  
ecology and conservation of biological diversity specialist;  
and USAID liaison

### Jennifer Grant

BS Certificate Forestry, Calvin College  
BS Forestry, Univ. of Michigan

Presently a recreation and lands specialist for the Craig  
Ranger District, Tongass National Forest, USDA Forest  
Service, Craig, Alaska, USA

Contribution: Authorship of Section E of Chapter 4 and  
Specialist Report #82A; training and extension evaluation  
specialist; and Peace Corps experience in Papua New Guinea

Linda L. Lind

BS Forestry, West Virginia University  
MS Forestry, Yale University

Presently the social forestry coordinator, International Forestry, Forestry Support Program, USDA Forest Service, Washington D.C., USA

Contribution: Authorship of Section D of Chapter 4 and Specialist Report #82B; socioeconomic assessment and development planning specialist; and Peace Corps experience in Fiji

David Schumann

BS Forestry, Univ. of Michigan  
MS Forestry and Forest Products, Univ. of Wisconsin

Retired. Formerly a utilization and marketing specialist for the Office of State and Private Forestry, Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin, USA

Contribution: Authorship of Section F of Chapter 4 and Specialist Report #82D; sawmill technology, wood utilization and products, transportation, marketing, and economics specialist

Thomas Thake

BS Forestry, Univ. of Wisconsin

Presently a silviculture, soil, and watershed specialist at the Supervisors Office of the Wayne-Hoosier National Forest, USDA Forest Service, Bedford, Indiana, USA

Contribution: Authorship of Sections A and B of Chapter 4 and Specialist Report #82E; soil and water resources, tropical silviculture, and harvest specialist; and Peace Corps experience in Malaysia

## APPENDIX B. CONSULTATION WITH OTHERS

### A. List of Contacts

#### WASHINGTON, DC - February 4 - March 3, 1992

Molly Kux, USAID, ASIA/DR/TR, Environmental Coordinator

#### SAN FRANCISCO, CALIFORNIA - Feb. 17, 1992

Dean Huber, USDA FS, Region 5  
Bill Hay, USDA FS, Region 5  
Bruce Grogan, FSP  
Stephen Berwick, FSP Consultant

#### PORT MORESBY, PNG - Feb. 21, 1992 (Scoping Meeting)

Keith Dolman, UNDP, TST (Forestry)  
Ruth Turia, Dept. of Forests (Planning Division)  
Johnson Mantu, Dept. of Forests (Task Force)  
Yati Bun, Dept. of Forests (Inventory Division)  
Emaus Toubu, Dept. of Forests (Resource Dev. Division)  
Goodwill Amos, Dept. of Forests (Investment Division)  
John Douglas, Dept. of Envir. and Conserv. (Planning Division)  
Steve Nicholls, Envir. Consultant (Dept. of Envir. and Conserv.)  
Stephen Mokis, Forest Industries Council  
Alan Familton, UNDP, TST (Team Leader)  
Basil Peutalo, UNDP, TST (NGO Coordinator)  
Andrew Kaulini, National Alliance of NGOs  
Rosa Laka, Friends of the Earth  
David Vosseler, PNG Director, FSP

#### PORT MORESBY, PNG - Other Personal Contacts

Ruth Turia, Dept. of Forests, (Planning Division)  
Johnson Mantu, Dept. of Forests (Task Force)  
Louis Kuhn, PNG Representative, USAID Regional Dev. Office  
Robert Farrand, US Ambassador to PNG  
Paul Neureiter, US Embassy Staff  
Bruce Telfer, Grome Pty. Ltd. (Forest Industry)  
Richard Stanley, UNDP  
Andrew Kaulini, SPATF  
Wanin Polly, Ex-Country Director, Peace Corps PNG  
Ian Kens, Consultant (soil-water)

#### LAE, PNG - Feb. 24, 1992 (Scoping Meeting)

David Skelton, Dept. of Forests (Bulolo Office)  
Augustine Pekeia, Dept. of Forests (Lae Office)  
Artuizo Paderia, Forest Research Inst.  
Bas Louman, Univ. of Technology, Forestry Dept.  
Beica Siki, Dept. of Forests (Morobe)  
Hoy Gape, Sawmill Tech.- Morobe (Private Sector)

**LAE, PNG (Cont.)**

Tony Naburau, NADEQUIP (sales)  
Peter Amatus, Wau Ecology Institute  
Ben Gewebing, Found. for Law, Order, & Justice  
Sasa Zibe, Village Development Trust  
Philip Holzknrecht, Niugini Resources Mgmt.

**LAE, PNG - Other Personal Contacts**

David Faunt, Manager, NADEQUIP  
Annabel Harford, Village Development Trust  
Philip Holzknrecht, Niugini Resources Mgmt.  
George Vatasan, Univ. of Technology  
Jeff Stocker, Univ. of Technology  
Matrus Kamung, Village Development Trust  
Lewis Veisami, Village Development Trust  
David Skelton, Dept. of Forests (Bulolo Office)  
Nevil Howcraft, Forest Research Institute  
Edward Nir, Forest Research Institute

**VILLAGE-SAWARA (Morobe Prov.) - Feb. 26, 1992 (Scoping Meeting)**

(approximately 35 village people attended)

**VILLAGE-BAU (Morobe Prov.) - Feb. 28, 1992 (Scoping Meeting)**

(approximately 50 village people attended)

**VILLAGE-KUNDIAWA (Simbu Prov.) - March 2, 1992**

Daniel Inaper, Principal Forestry Advisor, Dept. of Forests

**MT. HAGEN (Highland Prov.) - March 3, 1992**

Joe Ampe, Regional Forest Inspector, Dept. of Forests  
Aruai Kiske, Assistant Secretary, Dept. of Forests  
Kopun Timbers, New Development Banz  
Michael Michael, Area Forester, Kopun Tribe

**WASHINGTON, D.C. - March 3, 1992**

Alex Moad, USAID R&D/ENR

**VILLAGE-NAUKWATE (Oro Prov.) - March 5, 1992**

Michael Sumare, Sawmill Program Co-coordinator  
Philip Oam, Sawmill Program Co-coordinator

**WEWAK, PNG (East Sepik Prov.) - March 5-6, 1992**

Patrick Imarato, Assistant Secretary, Dept. of Envir. and Conserv.

Daniel Tamsen, Business Develop. Officer, Dept. of Envir. and Conserv.

Open Scoping Meeting (35-40 local land owners)

Francis Sumano, Planner, East Sepik Province

Monica Otto, Senior Planning Officer, East Sepik Province  
Officer

Mary Sunndrau, East Sepik Council of Women

**HONIARA, SOLOMON ISLANDS - March 12-18, 1992**

Tony Carmel, Solomon Islands Country Director, FSP  
Rt. Hon. Ezekiel Alebua, Chairman, SOLTRUST and ITHL  
Sister Paul Francis Gao, Secretary-Board, SOLTRUST  
George Kao, Program Manager, Eco-Forestry, SOLTRUST  
Brian Poika, Eco-forestry Officer, SOLTRUST  
Lino Papari, Eco-forestry Extension Agent, SOLTRUST  
Larry Christiansen, Volunteer in Overseas Assistance  
Marion Christiansen, Volunteer in Overseas Assistance  
Charles Sellers, Peace Corp Volunteer  
Paula Sellers, Peace Corp Volunteer  
Joseph Maleansia, Director, Univ. of South Pacific  
Tim Thorpe, Extension Forestry Advisor  
Kennedy Hoder, Forest Extension Officer, Dept. of Forests  
Tony Fearnside, Forest Inventory Team Leader  
Aiden Beveni, Principal Forestry Officer, Dept. of Forests  
Simeon Bouro, Senior Trade Officer, Dept. of Forests  
Bernard Telei, Senior Environmental Officer, Dept. of  
Forests  
Graham Baines, consultant (World Wildlife Fund)

**MALAITA PROVINCE, SOLOMON IS. - March 14-16, 1992**

Anisi Maeta-a', sawmill operator (Harasita Village)  
Stephen Tonafalea, sawmill operator (Anokelo Village)  
Edward Fosolla, sawmill operator (Auki)

**WESTERN PROVINCE, SOLOMON IS. - March 14-15, 1992**

Nusa Banga Village, sawmill operators  
Jim Bennet, sawmill operator  
Government Nursery Research Station (Munda)  
Issac Ostoni, sawmill operator (Choiselli Island)

**PORT VILA, VANUATU - March 18, 1992 (Dinner Meeting)**

Aru Mathias, VSSP Committee Member  
David Wood, VSSP Committee Member  
Jimmy Jonathan, VSSP Committee Member  
Jimmy Nipo, VSSP Committee Member  
Ernest Bani, VSSP Committee Member  
Charles Rogers, VSSP Committee Member  
Simon Swale, VSSP Committee Member  
George Borugu, VSSP Committee Member  
Kathy Fry, Vanuatu Country Director, FSP  
Joel Rawae, Training Officer, FSP  
Leonard Bule, Director, Dept. of Forestry  
Edwin Voss, European Commission  
Hon Tat Tang, So. Pacific Forestry Program, FAO  
Jenny White, Environmental Unit  
Peter Vuta, small sawmill owner  
Jack Hopa, small sawmill owner  
John Casey, HP Santo  
Karen Preston, FSP  
Jacques Yakan, VRDTCA

## **B. Scoping Process Narrative**

The following narrative describes the scoping activities that the PEA team conducted during the development of this programmatic environmental assessment. Documentation worksheets of scoping contacts and meetings are contained in the Project Record as Document #54 (See Appendix C).

An initial scoping meeting was held in San Francisco, California on February 17, 1992. Presentations were made to the PEA team by Dean Huber and Bill Hay from the Region 5 Office, USDA Forest Service. Dean expressed concern that both the ecological and processing/marketing side of forestry should be reviewed by the team. Bill provided the team with insights from his logging experience in the South Pacific.

Also present at the San Francisco meeting were Stephen Berwick and Bruce Grogan of the Foundation of the Peoples of the South Pacific (FSP). Steve briefed the PEA team on his recent trip to the study area. Bruce clarified how the project got started, how FSP is linked to USAID, and the FSP philosophy for the program.

The PEA team arrived in Papua New Guinea (PNG) on February 20, 1992 and met with David Vosseler (FSP Country Director), Alan Familton and Keith Dolman of UNDP/World Bank, Technical Support Project. The framework for the formal Port Moresby Scoping Meeting was established. The Scoping Meeting was conducted at the Department of Forests (DoF) from 8:30 to 11:00 AM on February 21, 1992. Thirteen people attended the meeting and represented the DoF and many NGOs (See the Contact List above).

On February 23, 1992, the PEA team traveled to Lae and met with Sasa Zibe of Village Development Trust (VDT). A field trip to Kamkumun and Gobadic areas was undertaken in the afternoon to view a "Wokabaut Somil" and an industrial logging operation. The operations in this area were not following Sasa's recommended field operation guidelines and he has subsequently suspended assistance to these operators until they conform to the prescribed sustainable forestry practices.

On the morning of February 24, 1992, the PEA team visited the VDT and NADEQUIP offices. The team interviewed staffs of both organizations and looked at the sawmill manufacturing process. A formal scoping meeting was held in Lae from 10:00 AM to 12:00 noon at the Forest Research Institute (FRI) building. Eleven people attended the meeting, representing the DoF and several NGOs (See Contact List above). In the afternoon, the team made several individual contacts at FRI. An interview with Philip Holzknacht was conducted during an evening meal session. Philip's family has lived in PNG since early the 1900's and his interview gave the team insights into the culture of the country.

The PEA team left for the Villages of Bau and Sawara on the morning of February 25, 1992. Field trips were conducted to visit old and new "Wokabout Somil" logging operations. Formal scoping meetings were conducted in Sawara on February 26, 1992, and in Bau on February 28, 1992. Several team members were allowed to run the sawmill and actually helped carry lumber back to the village (about 1.5 kilometers). The team was entertained in Bau with a "sing-sing", a traditional dance. The team gained valuable knowledge about the socioeconomic aspects of the village by being guests for four days. The village people were gracious hosts and the team made many new friends. The team returned to Lae in the Bau Village boat on February 29, 1992 (a five hour trip).

The PEA team separated to make additional scoping contacts in Port Moresby, Kundiawa, Mt. Hagen, and Wewak (See the Contact List above). A formal scoping session was held in Wewak and about 30-40 local area residents attended to inquire about the team evaluation underway in the country. The team regrouped in Port Moresby on the weekend of March 7 to finalize area contacts and work on drafting the environmental assessment. Team member Dave Schumann suffered a heart attack, and after a week in the Port Moresby hospital, was sent home on March 11, 1992. The rest of team left PNG for the Solomon Islands on March 12, 1992.

Tony Carmel, FSP Country Director, met with the PEA team on the evening of March 12, 1992, to finalize travel and contacts. On the morning of March 13, the team met with officials of SOLTRUST and Iumi Tugetha Holdings LTD (ITHL) and Tony Carmel. SOLTRUST and ITHL are the key NGO partners with FSP in the Solomon Islands. In the afternoon, Linda and Larry departed for Auki with George Kao, Eco-Forestry Project, SOLTRUST, and Tom and Jennifer departed for Munda with Brian Poika, Eco-Forestry Officer, SOLTRUST. Ron Senn remained in Honiara to interview Tony and work on the environmental assessment. The team regrouped in Honiara on the 15 and met with various people on March 17 (See the Contact List above). On March 18, the team held a final meeting with the NGO consortium and left for Port Vila, Vanuatu in the afternoon.

After arriving in Port Vila, the PEA team attended a discussion over dinner at the hotel (See the Contact List above). Kathy Fry was interviewed, but no time was allowed to visit field sites. The team left for Suva, Fiji on March 19.

The PEA team spent all their time in Suva, Fiji, from March 19 to March 23, preparing the final report of this programmatic environmental assessment. The report was presented on March 24 to a group of USAID and FSP officials. On March 26, the team disbanded and returned home.

The final draft of this report was prepared by team member Larry Ford, presently at USAID, Bureau for Research and Development, Office of Environment and Natural Resources, with assistance and consultation from the following people:

Pat Durst and Sally Claggett, USDA Forest Service, International Forestry, Forestry Support Program, Washington, D.C.

Molly Kux, Tobey Pierce, and Pam Muick, USAID, Bureau for Asia, Office of Development Resources, Technical Resources Division, Washington, D.C.

Ron Senn, USDA Forest Service, Region 3 Office, Land Management Planning, Albuquerque, New Mexico

Nancy Diamond, USAID, Bureau for Research and Development, Office of Economic and Institutional Development, Washington, D.C.

Johanna Welzenbach, USAID, Bureau for Research and Development, Office of Environment and Natural Resources, Washington, D.C.

APPENDIX C. - PROCESS RECORD INDEX and REFERENCES

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5	* Wildlife in Papua New Guinea	* David Liem	* 1978
6	* Birds of the North Solomons	* Don Hadden	* 12/1980
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22	* Relevance of "Walkabout Sawmills" to Areas Outside Papua New Guinea	* Pat Durst	* 7/1991 *
23	* Country Report: Papua New Guinea	* Dept. of Forests	* 10/1991 *
24	* Key Information From 1991 Heads of Forestry Reports (Vanuatu, Solomon Islands, Fiji, PNG, etc.)	* Institute of Pacific Islands Forestry	* 11/1991 *

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27	* Strengthening Environmental * Procedures Under 22 CFR 216 * *	* Bruce Bayle, * Don Howlett, * & Edward Toth *	* 1/1992 * *
28	* Status Report: PNG Conservation * Needs Assessment for Papua New * Guinea *	* Janis Alcorn * * *	* 1/1992 * * *
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30	* Scope of Work: Programmatic * Environmental Assessment - FSP * Portable Sawmill Program *	* Bruce Grogan * * *	* 1/1992 * * *
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54	* Scoping Meeting and Contact Worksheets	* Ron Senn, PEA Team	* 1992

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56	* Financial Planning Information on* * the Wokabout Sawmill *	* Richard * Stanley *	* 10/1991 * *
57	* Milland Fine Timber Catalog (PNG * section only) *	* Milland * Distributors *	* 1991 * *
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69	* PNG Analysis Assumptions for * Chapter 2 *	* Ron Senn and * Dave Vosseler* * *	* 3/8/92 * *
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81	* Sections From: Vanuatu 2ND Nat. * Development Plan *	* Unknown * *	* 1991 * *
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113	* An Ecological Approach to Forest * and Cultural History in Fiji	* Sean Weaver	* 1991 * *
114	* Policy on Indigenous Forest * Conservation	* Sean Weaver	* 1991 * *
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## **APPENDIX D. NARRATIVE, "WOKABAUT SOMIL" - DESIGN, DEVELOPMENT, and CHARACTERISTICS**

### **Sawmill Development History**

The first model of the portable sawmill, known as the "wokabout somil", was designed and developed during the early 1980's by Mursalin New, working with David Faunt, Paul Unwin, Pius Majai and a volunteer (#61). This mill belongs to the class of "dimensioning type" portable sawmills. Various designs of this type are manufactured by companies throughout the world. The name "wokabout somil" was first suggested by David Faunt in late 1983 after a request from Mursalin New for a translation into "tok pisin" of the generic term "portable sawmill" (#61).

The initial development of the wokabout somil was inspired by Dean Puzey of Illinois, USA. Mr. Puzey visited PNG in the early 1980's and kindly offered free use of his design. However his design could not be manufactured with the workshop facilities then available and a new design was developed. Construction of the first wokabout somils was carried out by the workers of Sain Enterprises Pty. Ltd. in the Kum-Gie workshop on Malekula St., Lae. Material requirements were provided by Village Equipment Suppliers, the trading arm of SPATF (#61). In 1986, Mursalin New completely redesigned the sawmill and also designed a manufacturing system for production of the mill. This design work was carried out with the assistance of the staff of Sain Enterprises Pty Ltd, then trading as "Wokabout Workshop".

In 1992, there are approximately 600 of this class of sawmill in Papua New Guinea, 45 in the Solomon Islands, and 4 in Vanuatu, a total of 649 in the study area. Additionally, Vanuatu has 1 New Zealand portable sawmill that is not so portable and 1 band saw type of sawmill. In all three countries numerous chain saw milling operations can also be found.

### **Sawmill Characteristics**

The current sawmill uses an 18 horsepower Briggs and Stratton gasoline cast-iron engine, which drives a 30-inch circular vertical main saw and a 12-inch circular horizontal saw. Both saw blades are 8 gauge and have 6 inserted B-pattern steelite tipped teeth. The engine and its two saws move along a rectangular lattice truss frame 8 meters long with a hand operated winch. The lattice truss frame slides along 3.25 meter crossbars which are mounted on four 2 meter by 50 millimeter posts. This allows the track to move both horizontally for the width of cut and vertically for the depth of cut. The saws move on the lattice truss frame for the length of the cut.

The truss frame and workbars are erected over a 6.5 meter log, or the logs are winched between the crossbars. Depending on the diameter of the logs, several logs can be winched into place side-by-side. This permits milling longer in the horizontal plane without changing the vertical set-up as often.

The entire mill weighs 350 kilograms. However the modular components can be carried by hand from site to site with a minimum of five individuals. The saws are capable of sawing a maximum dimension of 100 by 250 millimeters, or approximately 4 x 10 inches. A more realistic dimension is 50 x 100 millimeters, or approximately 2 x 4 inches, which allows for a reasonable feed rate without overheating the saw.

The price of the sawmill ranges from US\$7500 to \$11,000 depending upon the associated hardware included in the package, e.g. chainsaw, spare parts, field support, and training packages.

Sawmill attributes are as follows:

1. low capital investment;
2. low overhead costs;
3. portable, not requiring motorized transportation;
4. no roads or infrastructure are needed, which keep costs low, but also minimizes environmental damage;
5. employment, income, and other benefits are kept at the local level; and
6. flexible technology, which is adaptable to a variety of silvicultural systems and management objectives.

#### **Average Sawmill Figures for the Study Area**

**Production Rate:** The following lumber production rates were reported or observed:

Factory Specifications - 3 cubic meters/day (#54:D. Faunt)  
Actual - 1.24 cubic meters/day (#76)  
Actual - 4.0 cubic meters/month (#56)  
Actual - 100-500 cubic meters/year (#101)  
Actual - 1.0 to 1.5 cubic meters/day (#112)  
PEA Team Observation - 1.5 cubic meters/day

Production rates vary significantly from one mill operation to another. When sawmills are run as a pure business as in the East Sepik area of PNG, the higher production rates are common. When sawmills are run to produce lumber for community projects as at the Village of Sawara in PNG, the lower production rates are more common. For purposes of this environmental assessment, a production rate of 1.5 cu meters/day was assumed.

**Production Time:** The following periods of sawmill operation were reported:

Actual - 30 weeks per year or 7 months/year (#56)  
Actual - 26 weeks per year or 6 months/year (#101)  
Actual - 45 weeks per year or 10 months/year (#112)

Production time is directly related to the sawmill owners' purposes in operating the sawmill. Some villages ran their mill only when they needed lumber for community projects (10-15 days per month). At other villages, where profit motivation was the driving force behind mill ownership, sawmills were often run 20-25 days per month. For purposes of this environmental assessment, a production time of 15 days/month or 6 months/year was assumed for PNG and Vanuatu sawmills. Solomon Islands sawmills were assumed to run 10 months per year or 25 days a month.

**Crew Size:** The following sawmill crew sizes were reported or observed:

Factory Specifications - minimum of 5 (#54, Faunt)  
Actual - 10 crew members (#26)  
Actual - 14 crew members (#56)  
Actual - 6 crew members (#112)  
PEA Team Observation - 6-20 crew members

Crew size varied between 6 and 20 men depending on the sawmill owner's purpose. Profit-motivated operations generally held crew sizes down, while operations for purposes of community projects tended to have larger crews. Most crews were paid for their work, but in several situations crews were donating labor for the benefit of the communities. For purposes of this environmental assessment, a crew size of 6-8 members was assumed for all countries.

**Operating Costs:** The following operating costs were reported:

Actual Consumables - US\$60.00/cubic meter (#56)  
Actual Total - US\$85.00/cubic meter (354, Faunt)  
Actual Labor - US\$130/cubic meter (#56)  
Actual Total - US\$60/cubic meter (#112)

The operating costs listed above primarily take into consideration the consumables used in mill operation (e.g. oil, gasoline, parts, lumber treatment, etc.). Labor costs varied drastically depending on the objectives of the sawmill owners. It was very common for the crews working the mill to donate their labor to benefit a specific community purpose or general fund. For purposes of this environmental assessment, operating costs were assumed to be US\$60.00 for consumables and US\$120.00 for labor per cu meter. The total sawmill operating cost is US\$180.00/cu meter. These assumed costs are probably a little high for the Solomon Islands and Vanuatu, but were used for the whole study area nonetheless.

**Transportation Costs:** The following lumber transportation costs were reported:

Actual - US\$45.00/cubic meter (#56)  
Actual - US\$65.00/cubic meter (#82D)

Transportation costs vary as to the vehicle used to carry lumber to market. The above figures are based on coastal freight rates in Papua New Guinea. In the Highlands of PNG, many villages had purchased their own trucks and only hauled their lumber to local markets. The transportation costs in those cases are considerably lower. Many villages must use some form of coastal shipping to get their lumber to a central exporting market. For the purposes of this environmental assessment, transportation costs were assumed to be US\$50.00/cubic meter. These costs may be a little high for Vanuatu because most of the wood is used locally on individual islands where cheaper truck transportation is available. Considering the low number of mills involved in Vanuatu, it is appropriate to use the average transportation cost figures for the entire area for Vanuatu as well.

**Lumber Prices:** The following lumber prices were reported:

Actual - local markets US\$215/cubic meter (#54)  
Actual - Eco-timber export US\$325/cubic meter (#56)  
Actual - Eco-timber export US\$350/cubic meter (#112)

Prices received for lumber produced by portable sawmills varied depending on whether the wood was treated and whether the shipment was earmarked for export as eco-timber. One of the goals of the sustainable forestry program is to export lumber with an Eco-timber certification. Eco-timber has mainly been marketed through a U.K. organization called Ecological Trading Company (ETC). The Solomon Islands NGO group has been developing other markets in New Zealand and Australia. Data are not available for these new markets. For purposes of this environmental assessment, it is assumed that two-thirds of the production will be for local needs and one-third for eco-timber export. The consequent weighted average utilized in this environmental assessment is US\$250/cubic meter delivered to local markets or export shipping facilities.

#### **Effects Calculations**

The following figures were determined based upon the assumptions given above. Under the proposed program's mitigation guidelines, the maximum recommended number of trees to be harvested is 15 per hectare. The PEA team saw a great deal of variability by site. Some areas in PNG and the Solomon Islands had as few as 6 trees cut per hectare, while other areas had well over 20 trees cut per hectare. Assuming that not every hectare will be fully stocked with the size nor the marketable species, an average number of 12

harvest trees per hectare was estimated.

For the mills not following the mitigation guidelines, it was assumed that an additional 50% more trees would be cut, or a total of 18 trees per hectare. Because of the reportedly low number of trees per hectare on Vanuatu, an average figure of six trees per hectare was estimated.

In the determination of the number of hectares impacted, the following calculation was used. To determine hectares impacted, the daily production rate was multiplied by the number of days worked per year, which gave the total cubic meter output per sawmill. Total output was then divided by an average tree recovery volume of 3 cubic meters per tree to derive the total number of trees harvested in a year per sawmill. Total number of trees harvested was then divided by the number of trees that could be harvested under the management system to come up with the total impacted hectares per sawmill. Total impact for a country was determined by multiplying the number of hectares impacted per sawmill by the total number of sawmills.

Production rates were determined by taking the production rate per sawmill per year and multiplying by the number of sawmills in the program. Operating cost, which involved consumable and labor costs, equaled US\$180/cubic meter. In addition, a transportation cost of US\$50/cubic meter was assumed for a total cost per cubic meter of US\$230. Given the average selling price of US\$250/cubic meter the profit margin amounts to US\$20/cubic meter. Profit margin times production equals total profit per management system per country. Gross income equals selling price times the cubic meters of production.

See Tables 1, 2, 3, and 6 for the results of calculations.

**Table 6. Summary of Annual Rates for Hectares Impacted, Production, and Net Profits for Alternative 1 (No Action) and Alternative 2 (Proposed Action) within the Study Area. (Note: PNG = Papua new Guinea, SI = Solomon Islands, VAN = Vanuatu)**

**HECTARES IMPACTED - ALTERNATIVE 1 (No Action)**

<u>Country</u>	<u>1 Sawmill (ha/year)</u>	<u>All Sawmills (hectares/year)</u>		
		<u>Year 1</u>	<u>Year 5</u>	<u>Year 8</u>
<b>Sawmills Practicing Sustainable Forestry:</b>				
PNG	6	228	276	396
SI	10	160	0	0
VAN	12	72	360	360
Subtotals		460	636	756
<b>Other Active Mills:</b>				
PNG	4	1196	2436	3256
SI	6.6	33	106	67
VAN	0	0	0	0
Subtotals		1229	2542	3323
TOTALS		1689	3178	4079

**HECTARES IMPACTED - ALTERNATIVE 2 (Proposed Action)**

<u>Country</u>	<u>1 Sawmill (ha/year)</u>	<u>All Sawmills (hectares/year)</u>		
		<u>Year 1</u>	<u>Year 5</u>	<u>Year 8</u>
<b>Sawmills Practicing Sustainable Forestry:</b>				
PNG	6	228	816	2700
SI	10	160	1690	3180
VAN	12	72	360	360
Subtotals		460	2866	6240
<b>Other Active Mills:</b>				
PNG	4	1468	2380	2816
SI	6.6	53	198	0
VAN	12	0	0	0
Subtotals		1521	2578	2816
TOTALS		1981	5444	9056

Table 6. (Cont.)

**PRODUCTION - ALTERNATIVE 1 (No Action)**

Country	1 Sawmill (cu. m/year)	All Sawmills (cu.meters/year)		
		Year 1	Year 5	Year 8
<b>Sawmills Practicing Sustainable Forestry:</b>				
PNG	216	8208	9938	14256
SI	360	5760	0	0
VAN	216	1296	6480	6480
Subtotals		15264	16418	20736
<b>Other Active Mills:</b>				
PNG	216	64584	131544	175824
SI	360	1800	5760	3600
VAN	216	0	0	0
Subtotals		66384	137304	179424
TOTALS		81648	153722	200160

**PRODUCTION - ALTERNATIVE 2 (Proposed Action)**

Country	1 Sawmill (cu. m/year)	All Sawmills (cu.meters/year)		
		Year 1	Year 5	Year 8
<b>Sawmills Practicing Sustainable Forestry:</b>				
PNG	216	8208	29376	97200
SI	360	5760	60840	114490
VAN	216	1296	6480	6480
Subtotals		15264	96696	218170
<b>Other Active Mills:</b>				
PNG	216	79272	128520	110592
SI	360	2880	1080	0
VAN	216	0	0	0
Subtotals		82152	129600	110592
TOTALS		97416	226296	328762

Table 6. (Cont.)

**NET PROFITS - ALTERNATIVE 1 (No Action)**

Country	All Sawmills (US\$/year)		
	Year 1	Year 5	Year 8
<b>Sawmills Practicing Sustainable Forestry:</b>			
PNG	164,160	198,720	285,120
SI	115,200	0	0
VAN	25,920	129,600	129,600
Subtotals	305,280	328,320	414,720
<b>Other Active Mills:</b>			
PNG	1,291,680	2,630,880	3,516,480
SI	21,600	115,200	72,000
VAN	25,920	129,600	129,600
Subtotals	1,339,200	2,759,040	3,718,080
<b>TOTALS</b>	<b>1,644,480</b>	<b>3,087,360</b>	<b>4,132,800</b>

**NET PROFITS - ALTERNATIVE 2 (Proposed Action)**

Country	All Sawmills (US\$/year)		
	Year 1	Year 5	Year 8
<b>Sawmills Practicing Sustainable Forestry:</b>			
PNG	164,160	587,720	1,944,000
SI	115,200	1,216,800	2,289,600
VAN	25,920	129,600	129,600
Subtotals	305,280	1,934,120	4,363,200
<b>Other Active Mills:</b>			
PNG	1,585,440	2,570,400	2,211,840
SI	57,600	21,600	0
VAN	0	0	0
Subtotals	1,643,040	2,592,000	2,211,840
<b>TOTALS</b>	<b>1,948,320</b>	<b>4,526,120</b>	<b>6,575,040</b>

**APPENDIX E. PEA APPROVAL MEMO AND ACTION PLAN**



U.S. AGENCY FOR  
INTERNATIONAL  
DEVELOPMENT

FEB 18 1993

ACTION MEMORANDUM FOR THE ASIA BUREAU ENVIRONMENTAL COORDINATOR

FROM: Mary Herbert *Mary Herbert*  
Matching Grant Program  
USAID/FHA/PVC

SUBJECT: Sustainable Forestry Program  
Foundation for the Peoples of the South Pacific  
Project Number 938-0158  
Grant Number PDC-0158-A-00-1103-00  
Programmatic Environmental Assessment

Action: Your approval is requested on the attached Programmatic Environmental Assessment (PEA) of a Matching Grant to the Foundation for the Peoples of the South Pacific (FSP). Your approval is also requested on the attached Environmental Action Plan which specifies the most critical mitigation measures identified and described in detail in the PEA.

Background: The PEA was conducted as an environmental assessment requirement under 22 CFR Part 216 and in accordance with FAA Section 118(c)(14) and with Section 533(c)(3) of the FY91 Appropriations Act governing USAID assistance that affects tropical forests or involves logging activities. The Assessment was performed on a Matching Grant awarded to FSP by the USAID/FHA/PVC Office in Washington, D.C. The grant supports a five year effort entitled, "FSP/NGO Consortium Building Project for Sustainable Forestry Development," with a life of project funding level of \$1.6 million. As this is a matching grant, the total value, including FSP's contribution, is \$3.2 million.

The purpose of the grant, as specified in FHA/PVC's 1993 Project Portfolio, is:

To enable FSP headquarters to support an environmental project that conserves and sustains tropical rain forests as renewable resources by using professional/local NGOs to train local saw mill entrepreneurs how to cut and dress selected timber, and how to compete with large foreign lumber interests on world timber markets.

The proposed program is designed to reduce impacts on forest ecosystems and on local communities. It will provide assistance to improve small-scale, local forestry operations in a manner that recognizes indigenous tenurial and cultural rights and that emphasizes sustainable forest management as a less damaging alternative to larger, expatriate timber operations.

Discussion: The USAID contribution represents only 17 to 20% of the ultimate cost of the fully funded regional effort envisaged by FSP. The FSP regional community forestry program is designed as a four-country effort, cooperatively implemented by FSP affiliates in the U.S., Australia, Canada, the U.K., Vanautu, Solomon Islands, Papua New Guinea and Fiji. The full regional program will ultimately cost between \$15-20 million over a ten year period. In addition to support from USAID, funding has also been received from the European Economic Community, the Australian International Development Assistance Bureau and the MacArthur Foundation.

The region is unique and regionally important due to the great extent of remaining tropical forests, extremely high biodiversity, traditional forest ownership, and a well defined community structure. Small-scale, portable sawmill technologies are gaining popularity among traditional forest communities as an alternative to large scale industrial logging, which has often caused extensive environmental damage and failed to produce community level benefits. The new technologies, including the "Wokabaut Somil", enable forest-owning communities to maintain control over their natural resource base and to insure long term profit from sustainable forest management.

The PEA team examined two alternatives: i) implementation of the proposed FSP program or, ii) the do nothing or no action alternative. The team concluded that:

1. the program is needed to reduce the potentially significant impacts of the no action alternative,
2. assuming the safeguards and mitigation measures built into program design and further identified in the PEA are implemented, the program will result in no significant impacts, and
3. strong emphasis should be placed on continuous monitoring and evaluation of program administration, accomplishments and on-the-ground applications.

Legal Considerations: AID is restricted by statute in its ability to provide assistance to activities which involve logging and commercial timber extraction, unless an environmental assessment which meets certain conditions is completed. The text of these statutes is provided below:

**Foreign Assistance Act Section 118(c)(14)** states that, in providing assistance to developing countries, the President shall:

Deny **assistance** under this chapter for--

(A) **the procurement or use of logging equipment**, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will produce positive economic benefits and sustainable forest management systems;

**Section 533(c)(3) of the FY 91 Appropriations Act** states that:

None of the funds appropriated in this Act shall be available for any program, project or activity which would--

(A) result in any significant loss of tropical forests; or,

(B) **involve commercial timber extraction in primary tropical forest area** unless an environmental assessment:

(i) identifies potential impacts on biological diversity;

(ii) demonstrates that all timber extraction will be conducted according to an environmentally sound management system which maintains the ecological functions of the natural forest and minimizes impacts on biological diversity; and

(iii) demonstrates that the activity will contribute to reducing deforestation.

In accordance with the cited Section 533(c)(3), the EA identifies potential impacts on biological diversity of proposed logging activities and demonstrates that, to the extent timber harvesting operations are conducted using mitigation measures identified by the EA team, such operations will: be environmentally sound, maintain functions of the natural forest, minimize forest destruction and impacts on biological diversity, contribute to reducing deforestation and produce positive economic benefits and sustainable forest management systems. The PEA proposes a monitoring system intended to ensure mitigation measures are implemented, on the ground, over the life of the program. FSP managers have agreed to adopt the mitigation measures and monitoring system outlined in the PEA. Accordingly, PEA appears to

fulfill the requirements of FAA Section 118(c)(14) and Section 533(c)(3) of the FY 91 Appropriations Act--completion of which is a prerequisite to AID assistance to logging operations.

Recommendation: That you approve the PEA and the Environmental Action Plan which specifies the most critical mitigation measures, assigns responsibilities and provides a time-frame for action.

APPROVED: M. Kux  
Molly Kux  
Asia Bureau Environmental Coordinator

DISAPPROVED: \_\_\_\_\_

DATE: 2-24-93

Attachments:

Programmatic Environmental Assessment  
Environmental Action Plan

Clearance:

SJones, FHA/PVC	<u>SJ</u>	Date	<u>2/18/93</u>
LStamberg, FHA/PVC	<u>LS</u>	Date	<u>2/18/93</u>
PRamsey, GC/Asia	<u>PR</u>	Date	<u>2/19/93</u>
LFord, R&D/ENR	<u>LF</u>	Date	<u>2/19/93</u>
TPierce, ASIA/DR/TR	<u>TP</u>	Date	<u>2/19/93</u>

**ENVIRONMENTAL ACTION PLAN:**

**SUSTAINABLE FORESTRY PROGRAM  
for PAPUA NEW GUINEA, the SOLOMON ISLANDS,  
and VANUATU**

The "Sustainable Forestry Program for Papua New Guinea, the Solomon Islands, and Vanuatu" is a joint program of the U.S. Agency for International Development, Office of Private and Voluntary Cooperation (USAID/FHA/PVC), and the Foundation for the Peoples of the South Pacific (FSP) under matching grant number PDC-0158-A-00-1103-00. The matching grant is designed to strengthen the institutional capabilities of FSP and its local partners (LP), which, in turn, will result in the planned sustainable forestry assistance activities described in the attached Programmatic Environmental Assessment (PEA). The Sustainable Forestry Program is a multi-donor activity coordinated by FSP; therefore, responsibilities for some of the planned actions will be implemented in cooperation with all parties (AP), including both bilater and multilater donors.

The USDA Forest Service, Forestry Support Program conducted the PEA, and submitted the Draft Final to USAID on February 18, 1993. The PEA identified mitigation measures and additional recommendations for program implementation, which are summarized in the table below. The mitigation measures and recommendations are described in more detail in Chapter 1 of the attached PEA. Actions, the priority of each action, the party responsible for implementation, and a time frame for implementation are identified in the table.

ACTIONS	PRIORITY <sup>1</sup>	RESPONSIBLE PARTY <sup>2</sup>	COMPLETION DATE
<b>A. SUPPLEMENTARY PROGRAM OBJECTIVES</b>			
1. Increase the number of portable sawmills that join or stay in the FSP program. The program should place emphasis on designing, researching, and refining the "sustainable forestry" prescriptions, including the silvicultural and ecological management components.	1	AP	on-going
2. Follow the recommended guidelines in this PEA, but view them as dynamic, so they may be improved as better information becomes available.	1	AP	on-going
<b>B. PROGRAM INITIATION AND ADMINISTRATION</b>			
1. Define more precisely the specific cooperative roles and responsibilities for all stakeholder groups involved in the program.	1	LP	on-going
2. In the early stages of the program, focus primarily on the Solomon Islands; secondarily focus on Papua New Guinea.	1	LP	done

<sup>1</sup> Action Priority: 1=first, 2=second

<sup>2</sup> Responsible Party:

FSP=Foundation for the Peoples of the South Pacific

AP=All Parties (USAID, other bilateral and multilateral donors, and foundations)

LP=Local Partners

3. Focus the program on pilot areas and activities in each country. Use these pilots to gain experience and lessons before expanding country-wide.	2	AP	on-going
4. Inventory all existing portable sawmill operations, and improve existing sawmill operations, especially inoperable mills.	1	AP	end 1993
5. Develop a regional database on people and organizations involved in portable sawmill technologies, community forestry, and sustainable forestry in order to facilitate technology transfer and lessons learned from program successes and failures.	2	FSP	end 1993
6. Conduct a portable sawmill product market survey.	1	FSP and USAID/Suva	end 1993
7. Employ a full-time Regional Program Coordinator and additional staff as follows: a) Papua New Guinea: Country Program Coordinator, 3-4 Trainers, Extension Service Specialist b) Solomon Islands: 2-3 Trainers, Extension Service Specialist, Sawmill Engineer Consultant (1st month) c) Vanuatu: Country Program Coordinator, 2 Trainers, Extension Service Specialist.	1	FSP	end 1993
<b>C. TRAINING</b>			
1. Conduct training activities and improve training manuals about portable sawmill operations and forest management according to the detailed recommendations in the PEA.	1	FSP	on-going
2. Coordinate with other training institutions.	2	FSP	end 1993

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3. Promote government licensing of portable sawmills that is contingent upon successful completion of a certified training course.	2	AP	on-going
<b>D. EXTENSION</b>			
1. Conduct extension services related to sawmill operations and forest management according to the detailed recommendations in the PEA.	1	AP	on-going
2. Coordinate with existing extension services.	2	AP	on-going
3. Link the participating NGOs to government forestry offices by sharing resources and expertise.	2	AP	on-going
4. Develop provincial centers for the supply of parts and services, such as repairs, and for lumber treatment, secondary processing, and marketing.	1	FSP	mid 1994
<b>E. LAND USE PLANNING: Planning Considerations</b>			
1. Prepare overall landscape-level management plans and harvest plans for every project area identified according to the detailed recommendations in the PEA.	1	LP	on-going
<b>F. LAND USE PLANNING: Environmental Considerations</b>			
1. Base harvest plans on an inventory of timber and non-timber resources, ecological status of stands, regeneration potential, and critical biological diversity conservation elements; incorporate the detailed recommendations in the PEA.	1	LP	on-going

2. Incorporate post-harvest treatments, especially reforestation, in the harvest plan according to the detailed recommendations in the PEA.	1	LP	on-going
<b>G. SOCIOECONOMICS</b>			
1. Incorporate socioeconomic issues more explicitly into the program, especially the complex ownership patterns, traditional land use systems, decision making mechanisms, methods of benefit distribution, community-level social structures, and the role of women.	1	FSP and LP	on-going
2. Insure that rights and benefits accruing to program participants flow through the complex tenure and ownership systems to the recipients desired by the community.	1	LP	on-going
3. Incorporate traditional land use rights and practices into land management plans.	1	LP	on-going
4. Encourage local community participation, including from women, at all project stages.	1	LP	on-going
<b>H. WOOD PRODUCTS AND MARKETING</b>			
1. Insure that production and marketing practices promoted by the program will maximize efficient use of resources according to the detailed recommendations of the PEA.	1	LP and USAID/Suva	on-going
2. De-emphasize the importance of certification and marketing of "eco-timber"; instead, initial marketing efforts should firmly establish the local and national market structures before attempting even normal export market development.	2	FSP and LP	on-going

<b>I. RESEARCH</b>			
1. Foremost among research needs is a land-base inventory of forest types, commercial species quantity, and locations; in addition, research should be focused on answers to questions that address critical forest management problems according to detailed recommendations in the PEA.	2	National Government and Research Institutes	on-going
<b>J. MONITORING AND RE-EVALUATION</b>			
1. Focus monitoring activities on forest management areas according to the detailed recommendations in the PEA.	2	FSP	on-going
2. Distribute the information collected in the PEA record and as a result of research and monitoring activities to all FSP and affiliated organizations with responsibilities for forest management.	2	FSP	on-going
3. Conduct annual re-evaluations of program progress, including incorporation of recommendations from this PEA and adherence to the Environmental Action Plan.	1	FSP and USAID/FHA	on-going

SIGNED:

Bruce Grogan  
Bruce Grogan, FSP

DATE:

Feb 18, 1993

SIGNED:

Mary J. Herbert  
Mary Herbert, USAID/FHA

DATE:

2/18/93

1/8

APPENDIX F. LETTER FROM USAID/ASIA TO FSP



U.S. AGENCY FOR  
INTERNATIONAL  
DEVELOPMENT

FEB 24 1993

Mr. Stan Hosie, Executive Director  
Foundation for the Peoples of the South Pacific  
3550 Afton Road  
San Diego, Calif. 92123

Dear Mr. Hosie,

The Asia Bureau of USAID is very interested in the Matching Grant you received from our office of Private Voluntary Coordination for the Sustainable Forestry Program. We fully recognize that the USAID contribution represents only 17 to 20% of the ultimate cost of the fully funded regional effort envisaged by FSP. As you know, because of the program's potential environmental impacts, AID recommended that a Programmatic Environmental Assessment (PEA) be conducted as an environmental assessment requirement under 22 CFR Part 216, and in accordance with the Foreign Assistance Act Section 118(c)(14) and with Section 533(c)(3) of the FY 91 Appropriations Act governing USAID assistance that affects tropical forests or involves logging activities. The attached Action Memorandum, which I signed as Bureau Environmental Coordinator, describes the statutory requirements in more detail.

The PEA team concluded that:

1. the program is needed to reduce the potentially significant impacts of the no action alternative,
2. assuming the safeguards and mitigation measures built into program design and further identified in the PEA are implemented, the program will result in no significant impacts, and
3. strong emphasis should be placed on continuous monitoring and evaluation of program administration, accomplishments and on-the-ground applications.

To the extent that timber harvesting operations are conducted using mitigation measures identified by the PEA team and outlined in the attached Environmental Action Plan (EAP), such operations will: be environmentally sound, maintain functions of the natural forest, minimize forest destruction and impacts on biological diversity, contribute to reducing deforestation and produce positive economic benefits and sustainable forest management systems. The EAP includes a monitoring system intended to ensure mitigation measures are implemented, on the ground, over the life of the program.

We appreciate Bruce Grogan's contributions to the PEA and his assurances that FSP managers have agreed to adopt the EAP mitigation measures and monitoring system outlined in the PEA. It is also our understanding that FSP will share the PEA and accompanying EAP with all the other donors involved in the program.

We wish you all the best for your innovative program and look forward to information on its implementation. Please feel free to check with us on any of the substantive or legal issues discussed above.

Sincerely,



Molly Kux

Asia Bureau Environmental Coordinator  
Asia/DR/TR  
Room 3214 New State  
Washington, D.C. 20520

CC: David Leong, USAID/SUVA  
Mary Herbert, USAID/FHA/PVC  
Pat Ramsey, Asia/GC