Mt. VAEA ECOLOGICAL RESTORATION PROJECT

PHASE II

[TRIAL PHASE MAY 14-3 SEPTEMBER 2010]

CONSULTANTS FINAL REPORT

For the Ministry of Natural Resources and Environment (MNRE) and JICA Samoa

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Project Technical Advisor
September 3, 2010

THE MT. VAEA ECOLOGICAL RESTORATION PROJECT PHASE II: This report details the main activities and outcomes that took place during the trail phase (Project Phase II continuation) from May 14-September 3, 2010. Previous project phases took place as follows: Phase I September 2007-January 2008 (CI PIP Principle Partner) followed by Phase II (trial initiation) May 2009- February 2010 (JICA Principle Partner).

The report structure and outline follows those recommended by the Project Advisory Committee (Table 1) and that which was detailed in the consultants contract TOR (ANNEX A). The Mt. Vaea Ecological Restoration project itself was initiated back in 2007 and has continued steadily ever since in various phases based on the information and knowledge required, and funding available from our principle partners and interested donors (e.g. RLS Foundation, CI and JICA). The project has been designed and under the supervision of both a selected Project Advisory Committee and the staff of MNRE Parks and Reserves Division. The original concepts of the project remain true today and the Mt. Vaea Ecological Restoration Project has two main objectives as follows:

1. To restore the Mt Vaea reserve forested area to its former state with the appropriate native rainforest forest tree species and site specific enhanced native biodiversity (both flora and fauna);
2. To become a "classic" demonstration site of invasive species management (ISM) and habitat restoration for Samoa and the rest of the Pacific Island Region.

TABLE 1: MT. VEAE Restoration Project Committee and Key Technical Staff

Name	Designation/Organization	Contact Details
Faleafaga Toni Tipamaa	ACEO DEC/MNRE	Ph. 22481 ext. 57
Dr. Hitofumi Abe*	(Former) JICA Chief Advisor Enhancing Management Capacity Project National Parks and Reserves/MNRE	JICA Office Tokyo, Japan
James Atherton	Conservation Outcomes Manager/CI PIP	Ph 21593
Suemalo Talie Foliga	Principle National Parks and Reserves Officer/MNRE	Ph 28680
Dr. Alan Tye	Invasive Species Officer SPREP	Ph 21929 ext. 270
Josef Pisi	National Reserves Officer	Ph 28680
Isamaeli Asotasi	Senior National Reserves Officer	Ph 28680
Lokeni. Perenise	Project Temporary Hire [May-September, 2010]	Ph 28680
Maeva. Misipati	Project Temporary Hire [May-September, 2010]	Ph 28680
Vaga Tuilimu	Project Temporary Hire [May-September, 2010]	Ph 28680

*= Currently with Japan International Cooperation Agency JICA Advisor (Forestry) Tokyo, Japan

In order to achieve the project overall objectives and main goals all future efforts will require the continued commitment of MNRE and its partners, as well as, significant financial and human and resources for a significant period of time.

The overall recommendations presented in this report are a combination of the following:

1. Earlier project work conducted during PHASE I including transect data and general recommendations;
2. Recent suggestions and concepts from similar work and overseas efforts, and of course;
3. The re-census work, trial results and data, observations, and experience gained during this phase of project implementation.

INTRODUCTION TO THE PROJECT: The Mt. Vaea Ecological Restoration Project started in earnest in mid-September 2007, when the then Project Management (Conservation International) with the approval of the Implementing Agency, [MNRE, Division of Environment and Conservation (DEC), National Parks and Reserves Section (NPR)], seconded the Project Technical Expert to initiate and conduct the field work stipulated in the contract. The Mt. Vaea Ecological Restoration Project has two main objectives as follows:

1. To restore the Mt Vaea reserve forested area to its former state with the appropriate native rainforest forest tree species; and
2. To become a "classic" demonstration site of invasive species management (ISM) and habitat restoration for Samoa and the rest of the Pacific Island Region.

The field survey and plant inventory work for Phase I started in early October, 2007 and took place over a six-week period which required 13 separate mountain excursions (8.10 to 21.11.07) to complete. The field surveys conducted provided volumes of information and the initial results paint a poor picture of overall forest health with the severe impacts of present invasive species being very obvious throughout the whole project area and reserve. Maps, using the survey data from both transect and observation blocks for each target species were generated using MapInfo GIS software and illustrate their distribution and relative importance (refer to PHASE I report). The following general information has been gleaned from the project survey data sets and distribution maps (see Figure B):

- The whole project area has been severely impacted by invasive species as well as by both human related (e.g. agricultural and forestry) and natural calamities (e.g. cyclones, severe weather events, etc.) particularly over the last several decades.
- In all transects surveyed and measured [34 out of the 36 (2 were inaccessible)], a total of 1,858 plant/stems were recorded and averaged 54.6 stems per transect with a low of 24 and a high of 114 stems measured.
- Overall within the transect blocks surveyed the species diversity was generally low, with the total number of woody/herbaceous species recorded being 68 of the 78 total species recorded and/or observed and they ranged from a low of 3 to a high of 17 species per transect.
- Total percentage of invasive species abundance (ISA) of all species recorded in 34 transects was **62%** with **57.6%** being the top 5 target species alone.
- Total percentage of calculated dominance (ISD) all invasive species in transects was **60.6%** with **59.3%** being the top 5 target species alone.
- Invasive species scored high as well in the observation blocks (canopy 1&2) comprising a total of **42.3%** of all the scores again with **90%** being the top 5 target species alone.
- Even the 5 least impacted transect blocks ranged from **9.8-29.8%** ISD and had one or more of the target species present.

Based on all the survey results, the top five IAS were defined on the basis of their importance (abundance by stem number) within the project area and dominance amongst all the other invasive species present. Further criteria included their relative difficulty of control as are seen as species likely to be controlled but will not be replaced by desirable natives without an active restoration program. The order of priority also considered these species as those that alter ecosystem processes and out-compete native species, and that can prevent or depress recruitment of natives. The top 5 target species that were ranked according to their relative importance are as follows:

1. ***Castilla elastica*** [Mexican Rubber Tree], Samoan= "PULU MAMOE"
2. ***Funtumia elastica*** [African Rubber Tree], Samoan= "PULU VAO"
3. ***Spathodea campanulata*** [African Tulip Tree], Samoan= "FA'APASI/TULIPE"
4. ***Albizia falcataria*** [Albizia] Samoan= "TAMALIGI PA'EPA'E"
5. ***Albizia chinensis*** [Albizia] Samoan= "TAMALIGI ULIULI"

The Mt. Vaea Project in its initial phase was quite successful in establishing a platform for continued research and a significant database for overall biodiversity (both plant and animal) and of course the identification and assessment of the key invasive species within the reserve to date.

Following this initial project phase the JICA National Parks and Reserves Project (Enhancing Management Capacity for National parks and Reserves) together with MNRE Division of Environment and Conservation (DEC) developed the concept for a second research phase to address the key management issues concerning these 5 target invasive species. The first of this project Phase was executed during the period May 2009-February 2010 and general research design and initial trial implementation was conducted. Following this a continuation was discussed at several meetings with the advisory committee and a final TOR was established and contract with the Technical Advisor re-commenced on May 14, 2010 (see consultants TOR appendix A). The contract had 3 sub-divisions based on deliverables to be completed and payment schedules these included:

1. Work-plan development and implementation planning;
2. Procurement of chemicals and equipment, pesticide safety and staff training, field trial establishment and baseline data collection; Initial treatment implementation and results data collection, analysis and management.

THE PROJECT AREA DESCRIPTION: The Mt. Vaea National Park and Reserve is located about 3.5km south of Apia, along the Cross Island road going toward the Falealili District. The main access to the reserve has given the name "Ala o le Alofa Road" or "The way of love Road" since the times of the famous Scottish author, Robert Louis Stevenson resided there. The reserves total land area is about 183 hectares and currently serves three main functions for the country these being: Recreation, Historical/Education, and Conservation. The reserve is also rich in historical importance as well having several recognized national landmarks and important national heritage events as follows:

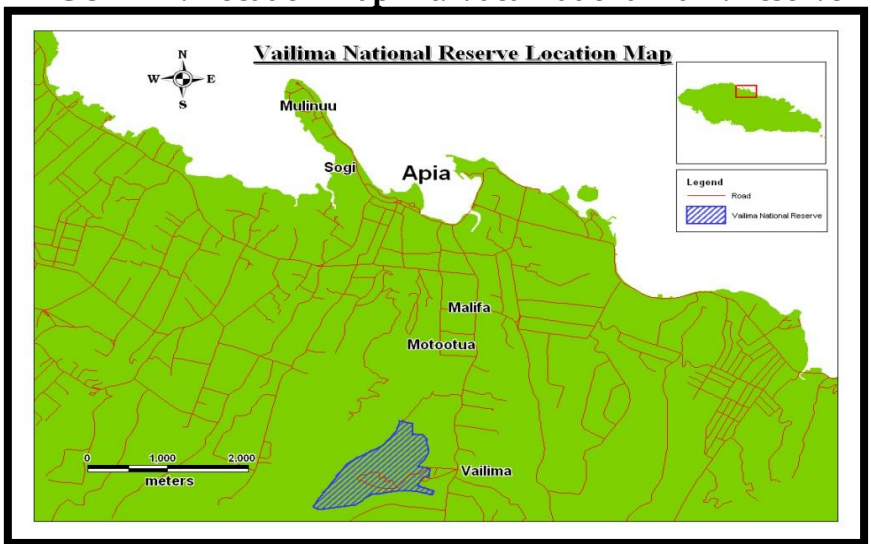
- Significant European historical site in Samoa since first European contact;
- Residential place of late Robert Louis Stevenson (RLS) between 1890 – 1894
- Associated with RLS house is the Stevenson's pool and RLS tomb below the summit of Mt. Vaea.
- The Later Estate became home of the late Head of State and as a reception area for visiting dignitaries.
- Development of the Vailima Botanical Garden and First Arbour Day in 1978
- Experimental Trial of exotic tree species by the Forestry Division of the Ministry of Agriculture, Forests, Fisheries and Meteorology
- Currently managed by the National Reserve Section of the Division of Environment & Conservation, Ministry of Natural Resources & Environment

Mt. Vaea reserve is the most visited of all Samoan national parks and reserve areas and is a very popular recreational site being only a few minutes drives from downtown Apia. The reserve is currently utilized annually as follows:

- About 28,000 people visiting the reserve annually;
- 16% are tourists
- 84% are locals
- 76% of local visitors visiting the reserve more than once a week.
- Male – 63%, female – 37%

Despite its rich historical heritage and biological diversity, the reserve is also heavily impacted by invasive weeds which are slowly spreading in the reserve, a characteristic that has accelerated during post-cyclone periods and current recreational usage. One of the impacts of the spread of invasive weeds is that the diversity of native birds, plants, reptiles and other native species are being reduced due to the loss of their natural habitats and ecosystems. The further loss of native biodiversity will continue unless invasive species management is imminently fast-tracked and implemented, thus the rationale for these projects.

FIGURE A: Location Map Mt. Vaea National Park/Reserve



TRIAL ESTABLISHMENT, METHODOLOGY AND APPROACH: Prior to the establshment of the final trial block several site options were discussed based on the survey data and information obtained during phase I. Initially 5 one hectare blocks were proposed for the trial (4 treatment and 1 control block) based on their respective numbers (i.e. relative abundance) of the two specifc target tree species of major concern (e.g *Castilla elastica* and *Funtumia elastica*). Later a single hectare was selected by the advisory group to be used as a permanent trial/survey plot for the initial research phase and ecological assessment. It was considered that a smaller total trial area located in a more centralized location would be more manageable and sustainable in the longer-term (FIG B). A field team was employed through project funds and a trial block was established being located more conveniently closer to the main trail network. The block was pegged out using cut pieces of standard PVC pipe and layout was measured out in 10m x 10m subplots (e.g. quadrates) and measured using a standard field tape measure and a tripod (surveyor's) compass all distances were adjusted and calculated to compensate for slope (see also Figures B & C).

The slope was collected in the field as follows.

1. Use tripod (surveyors) compass to sight all marking pins (e.g. pickets) set at 10m x10m intervals.
2. Mark the direction (due north and due east) we need.
3. Measure the slope angle.
4. Calculate required slope distance using the measured slope.
5. Example: When we need 10m horizontal distance measured, and the slope was 20 degrees.
   10 (m) / *cos* 20 (degree) = 10.64 (m) Plant the picket at 10.64 m

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TRIAL CHEMICAL TREATMENT METHODOLOGY and APPROACH: Based on an extensive species specific internet search for any control (focusing on chemical) information regarding the 5 target invasive species in the reserve 3 chemical herbicides were chosen for trial. These 3 products were seen as the best potential herbicides especially when employing two different application methods (Triclopyr only). These treatments were taken under consideration especially in light of the labour costs, application (i.e. site accessibility) and the extent of the longer term control over the whole reserve requiring treatment. The chemical treatments focused particularly of the two problematic rubber species (e.g. ***Castilla elastica*** and ***Funtumia elastica***) as the other 3 species (***Spathodea campanulata*** [African Tulip Tree],

A***lbizia falcataria*** [Albizia]; ***Albizia chinensis*** [Albizia]) had "fairly well documented" recommendations for chemical herbicide treatments from both within and outside Samoa and therefore they were of lesser concern.

The following herbicides and application methods were decided to be used in the trial as treatments with their respective field colour codes painted as a cross (+) on each treatment tree throughout entire trial block:

1. Treatment **A (Block 1) =** Triclopyr H&S (hack and squirt) **RED PAINT**
2. Treatment **B (Block 2) =** Banvine H&S (hack and squirt) **BLUE PAINT**
3. Treatment **C (Block 3) =** Glyphosate H&S (hack and squirt) **WHITE PAINT**
4. Treatment **D (Block 4) =** Triclopyr B&B + Diesel (Basal bark spray) **RED PAINT**

The two of the more common application methodologies used for chemical treatment of forest tree species are hack and squirt (or frill) and basal bark spray application techniques. Other application methodologies such as stump spraying, drill or root injection methods seemed neither practical nor affordable under the current Mt. Vaea Project conditions. Furthermore, each of these techniques are only stated as suitable and/or recommended by the manufacturers for certain herbicide formulations. Based on this information and the manufacturer recommendations only the Grazon (Triclopyr 600g/l concentrate) was recommended to employ both methods/application techniques in the trial.

In addition to the two species to be tested it was also seen as necessary to test the response of each species to the chemical treatment in relation to tree size measured as DBH (i.e. age or maturity) as the within the reserve there existed a whole range circumstances especially when considering the level of forest disturbance (both human and natural) that has taken place in various locations over the last several decades.

The initial census/survey data was then analyzed to determine the distribution of actual tree numbers of each species per size class which would allow for a suitable trial layout and design [Tables 2&3].

Therefore, because of the wide variation in number and size of each target species observed and recorded in the initial trial block survey/establishment the trial design for the 4 treatments (i.e. chemical vs. species vs. size class) over the 1 hectare block was as follows:

TABLE 2: MT. VAEA TRIAL DESIGN DETAILS

MT. VAEA CHEMICAL TREATMENT* TRIAL EFFICACY DESIGN DETAILS [TREE NUMBERS]

Species	DBH*	Treatment A	Treatment B	Treatment C	Treatment D	Total #
Castilla elastica	**5-20cm**	40 [21]	40 [67]	40 [107]	40 [90]	160 [285]
“”	**>20cm**	10 [5]	10 [15]	10 [21]	10 [9]	40 [50]
Total Species/Treatment		**50 [26]**	**50 [82]**	**50 [128]**	**50 [99]**	**200 [335]**
Funtumia elastica	**5-20cm**	40 [163]	40 [132]	40 [145]	40 [196]	160[636]
“”	**>20cm**	6 [9]	6 [6]	6 [9]	6 [11]	24 [35]
Total Species/Treatment		**46 [172]**	**46 [138]**	**46 [154]**	**46 [207]**	**184 [671]**
GRAND TOTALS TREATED		**96**	**96**	**96**	**96**	**384**
GRAND TOTALS AVAILABLE		**[198]**	**[220]**	**[282]**	**[306]**	**[1006]**

DBH = was measured to the nearest tenth of a cm, therefore <20cm =small size class and >20cm is large;

*= As stipulated above: A= Triclopyr H&S; Banvine H&S; Glyphosate H&S; Triclopyr B&B + Diesel

[###] = number of available trees present in treatment block based pre "*RENE"* census data.

BLOCK A PM	TABLE 3: SPECIES DISTRIBUTION BY SIZE CLASS AND SPECIES ALL BLOCKS PM ONLY *Castilla elastica* TRIAL BLOCK CENSUS DATA (25.01.09)							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
6-10		4	1	0	0	0	0	**5**
16-20		6	3	2	1	1	0	**13**
26-30		0	0	0	0	0	0	**0**
36-40		0	0	1	0	0	1	**2**
46-50		2	0	2	1	1	0	**6**
Substitutes		-	-	-	**C#245, C#319, C#279**	**C#552, C#313**	-	-
Totals		**12**	**4**	**5**	**2**	**2**	**1**	**26**
BLOCK B PM	**PULU MAMOE (PM) *Castilla elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
56-60		3	1	0	0	1	0	**5**
66-70		1	3	5	1	0	0	**10**
76-80		10	7	5	2	1	2	**27**
86-90		10	5	1	0	0	1	**17**
96-100		7	5	4	3	2	2	**23**
Substitutes		-	-	-	-	-	-	-
Totals		**31**	**21**	**15**	**6**	**4**	**5**	**82**
BLOCK C PM	**PULU MAMOE (PM) *Castilla elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
1-5		26	11	4	5	1	2	**49**
11-15		14	13	3	3	0	0	**33**
21-25		10	3	4	2	1	1	**21**
31-35		7	3	1	0	1	1	**13**
41-45		7	1	0	1	2	1	**12**
Substitutes		-	-	-	-	-	-	-
Totals		**64**	**31**	**12**	**11**	**5**	**5**	**128**
BLOCK D PM	**PULU MAMOE (PM) *Castilla elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
51-55		10	0	0	0	0	0	**10**
61-65		2	3	0	0	0	1	**6**
71-75		8	6	3	3	0	1	**21**
81-85		14	5	2	2	0	0	**23**
91-95		23	13	1	0	2	0	**39**
Substitutes		-	-	-	-	-	-	-
Totals		**57**	**27**	**6**	**5**	**2**	**2**	**99**
TOTAL/ PM		**164**	**83**	**38**	**24**	**13**	**13**	**335**

BLOCK A PV	TABLE 4: SPECIES DISTRIBUTION BY SIZE CLASS AND SPECIES ALL BLOCKS PV ONLY *Funtumia elastica* TRIAL BLOCK CENSUS DATA (25.01.09)							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
6-10		13	3	2	1	0	0	**19**
16-20		12	4	1	0	0	1	**18**
26-30		20	8	5	1	0	0	**34**
36-40		29	9	4	1	0	0	**43**
46-50		35	15	3	4	1	0	**58**
Substitutes		-	-	-	-	-	-	-
Totals		**109**	**39**	**15**	**7**	**1**	**1**	**172**
BLOCK B PV	**PULU MAMOE (PV) *Funtumia elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
56-60		14	8	4	1	0	0	**27**
66-70		31	9	5	3	0	0	**48**
76-80		24	11	1	1	0	0	**37**
86-90		7	3	0	0	0	0	**10**
96-100		13	2	0	1	0	0	**16**
Substitutes		-	-	-	**B#962, B#987**	**B#1339**	-	-
Totals		**89**	**33**	**10**	**6**	**0**	**0**	**138**
BLOCK C PV	**PULU MAMOE (PV) *Funtumia elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
1-5		8	2	0	0	0	0	**10**
11-15		7	3	0	0	0	0	**10**
21-25		22	9	2	1	0	0	**34**
31-35		31	4	3	1	0	1	**40**
41-45		48	4	2	5	1	0	**60**
Substitutes		-	-	-	**D#887, D#1333, V#4, V#5**	-	-	-
Totals		**116**	**22**	**7**	**7**	**1**	**1**	**154**
BLOCK D PV	**PULU MAMOE (PV) *Funtumia elastica***							
Transect Range No.	**Size Class**	**5-10 cm**	**10-15 cm**	**15-20 cm**	**20-30 cm**	**30-40 cm**	**>40 cm**	**TOTALS**
51-55		34	4	0	3	0	0	**41**
61-65		34	13	3	2	0	0	**52**
71-75		47	8	2	3	1	0	**61**
81-85		22	1	0	1	1	0	**25**
91-95		23	4	1	0	0	0	**28**
Substitutes		-	-	-	-	-	-	-
Totals		**160**	**30**	**6**	**9**	**2**	**0**	**207**
TOTAL/PV		**474**	**124**	**38**	**29**	**4**	**2**	**671**

FIGURE B. Mt. Vaea Permanent Survey/Trial Block Layout

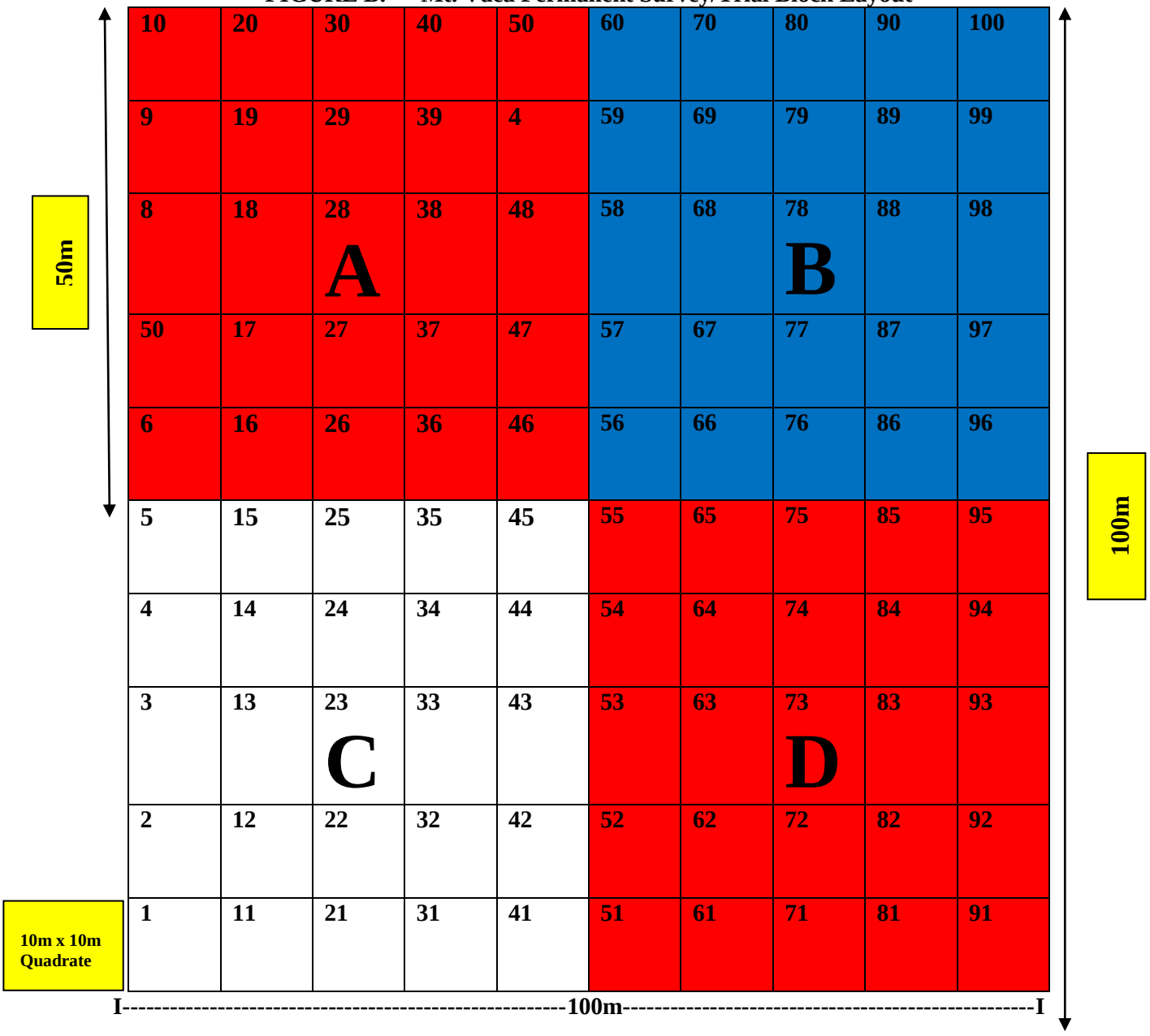
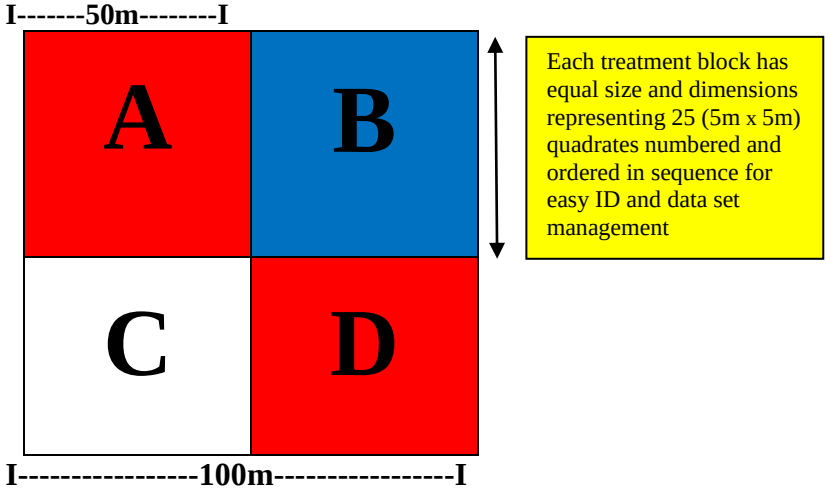


FIGURE C. Trial Treatment Layout

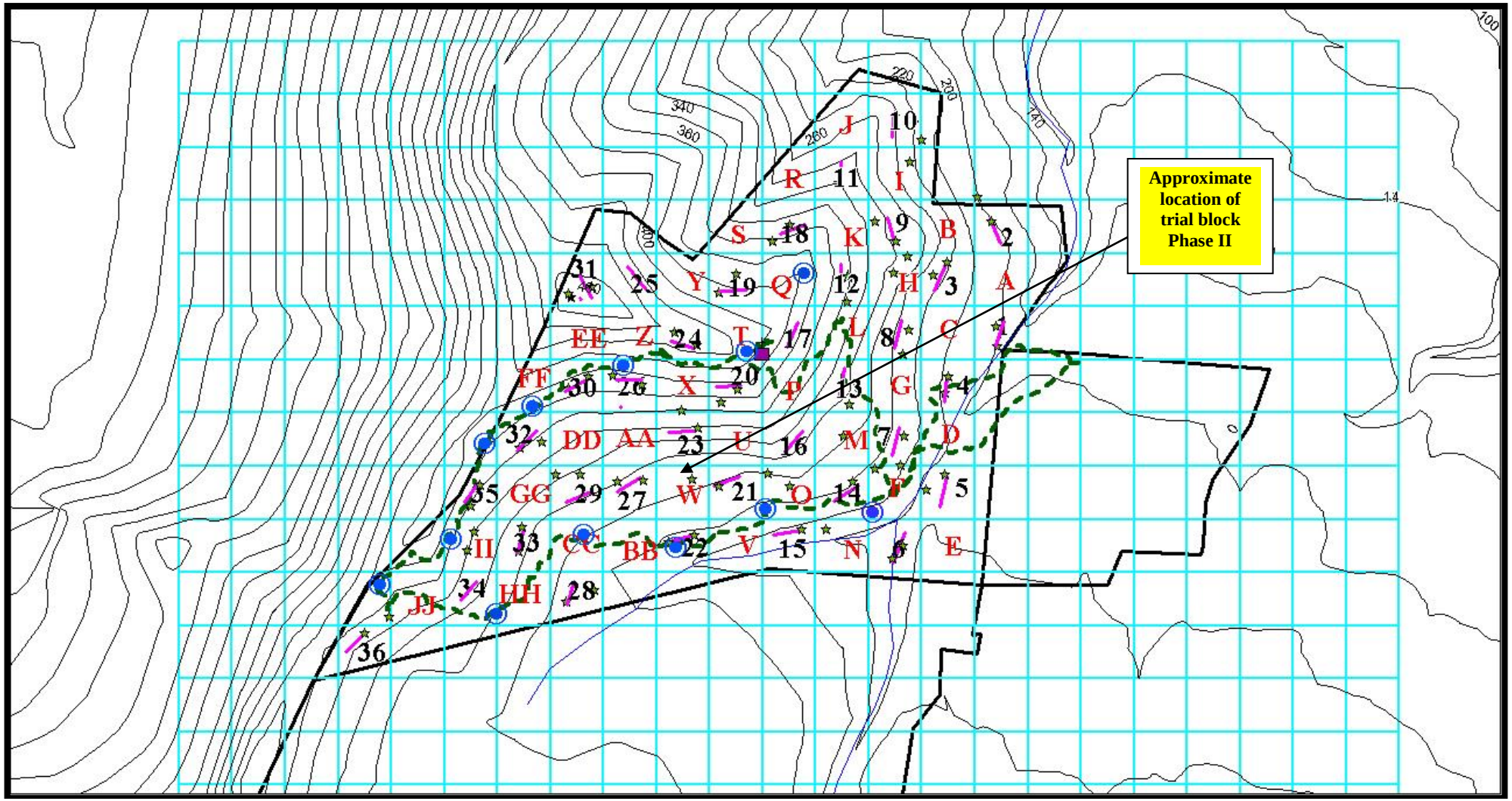


TREATMENT CODES

Treatment A= Block 1; Treatment B= Block 2; Treatment C= Block 3; Treatment D= Block 4

A= Triclopyr H&S (hack and squirt) **RED PAINT**
B= Banvine H&S (hack and squirt) **BLUE PAINT**
C= Glyphosate (hack and squirt) **WHITE PAINT**
D= Triclopyr B&B (Basal bark spray) **RED PAINT**

FIGURE D: MT. VAEA PROJECT WHOLE AREA MAP



---- = Reserve Public Trails A, B, C = Observation Blocks 1, 2, 3 = Transect Blocks ___ = Initial Transect Location

■ = Actual Bird Survey Sites * * = Actual Transect Waypoints ■ =RLS Tomb □ = 1 ha grid

SUMMARY OF WORK COMPLETED: The following section details the main project activities that took place since contract commencement on May 14, 2010 from the outset of this phase it was understood that this was a continuation of previous work initiated by the same project and principle. Therefore, some of the planning, preparations, communications, meetings, and discussions with the project advisory committee had taken place just prior to contract commencement. This was deemed necessary in order to ensure for more efficient project implementation and delivery. Some of the key deliverables outlined in the contract are listed below and those highlighted have been completed as of this reporting period.

- **20% (WST 3,000) upon signing of contract and commencement of full implementation plan;**
- **20% (WST 3,000) upon approval of submitted implementation plan;**

INITIAL PAYMENT COMPLETED FOR DELIVERABLES [INVOICE #1 May 19, 2010]

- **20% (WST 3,000) after completion of all trial treatments and data collection identified in plan;**

2nd PAYMENT COMPLETED FOR DELIVERABLES [INVOICE #2 July 13, 2010]

- **40% (WST 6,000) after the completion of data management and reporting**.

PAYMENT AT COMPLETION OF REPORT AND CONTRACT

[Also see ANNEX A (Contract Special conditions) & B (approved Implementation Plan) for full details]

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1. **IMPLEMENTATION PLANNING:** As mentioned earlier several discussions and meetings during the break between (3 months) the two contract phases. During these meeting the planning for the continuation of trial implementation was set in place and an implementation plan was developed for use during the phases of remaining research actions (see Annex.
2. **RE-CENSUS:** Perhaps the most significant activity during this period was the field work done by the designated field team (e.g. Sue'malo Talie Foliga, Isamaeli Asotasi, Joe Pisi, and field crew) in conducting total re-census of the whole trial block 1 hectare in size. This was deemed as necessary by the committee as damages caused by tropical storm "*Rene*" were observed during a routine trial monitoring exercise and reported during a project meeting. This involved the assessment and re-measuring of each and every tree originally identified in the trial block and an re-evaluation on its current status with regard to the following scientific parameters (See also FIG. B & C for diagrammatic illustration):
    - Diameter Breast High (DBH to nearest cm) and species composition;
    - Status regarding trial protocols (e.g. Native species vs. Invasive species and weather previously treated or not) and evaluation (broken vs. forked, suitability for treatment, etc.);
    - Present condition and weather damaged, unaffected and suitable for trial use, and/or partially damaged).
    - Overall conditions of forest re-growth within trial block (e.g. new invasive incursions, regeneration and/or recruitment of native species, etc.).
3. **DATA INPUT:** Following the re-assessment all data collected needed computer input and cross checking and verification with field data sheets. Following verification of the new data set the data was then again reorganised, ranked and sorted by species, DBH, Condition Status (e.g. normal, changed [damaged], previously treated) and location by block and quadrate for initial pivot table analysis (see also attached excel file: ***post_cyclone final for Pivot Corrected Mark DataFINAL***). All data set information has been backed up (electronically) in several locations and is stored on hard drives amongst the project committee members for safe keeping and future usage. It should be noted here that the main computer at the Vailima Station has been a constant challenge for the project throughout the whole trial period. The computer's severe virus problem have crippled most internet communications and the unreliability of safe data storage and data transfer has increased significantly the costs of travel and data transfer for senior field staff and Project Technical Advisor throughout this phase of the project.
4. **TREATMENT OF LARGE TREES and RE-SCHEDULE OF TREATMENT SMALL TREES (<20cm DBH) POST RE-CENSUS FOR IMPLEMENTATION:** A separate spreadsheet was developed specifically for the two target species used in the trials and these were separated, sorted and reorganised again by species, DBH, block, quadrate and tree number. This was done for easier selection of treatment trees (40 small size class [<20cm DBH] x 2 Species x 4treatments = 320 trees in total) and was conducted starting from the largest – smallest DBH order. In two of the blocks there were an insufficient number of trees available for one of the species and therefore, it was agreed to use substitute trees from and adjacent treatment block which had an excess of the required species (See also TABLE 7&8).

TABLE 5: MT. VAEA TRIAL TREATMENT TREES (LARGE) MONTHLY MONITORING SCHEDULE 2010													
Treatment	**Application Date**	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**
A	22.12.09	26-Jan	23-Feb	22-Mar	21-Apr	21-May	21-Jun	21-Jul	20-Aug	20-Sept	20-Oct	19-Nov	20-Dec
B	22.12.09	26-Jan	23-Feb	22-Mar	21-Apr	21-May	21-Jun	21-Jul	20-Aug	20-Sept	20-Oct	19-Nov	20-Dec
C	16.12.09	21-Jan	23-Feb	19-Mar	20-Apr	21-May	21-Jun	21-Jul	20-Aug	20-Sept	20-Oct	19-Nov	20-Dec
D1*	26.02.10	X	X	26-Mar	26-Apr	26-May	28-Jun	28-Jul	28-Aug	28-Sept	28-Oct	29-Oct	20-Dec
D2*	27.04.10	X	X	X	X	27-May	28-Jun	28-Jul	28-Aug	28-Sept	28-Oct	29-Oct	20-Dec
Large Trees [>20cmDBH] 64 trees Total (PM =40 & PV = 24)													

***=**D Treatment was delayed due to post cyclone re-census work and bad weather; D1= 3 trees; D2= 7 trees

TABLE 6: MT. VAEA TRIAL TREATMENT TREES (SMALL) MONTHLY MONITORING SCHEDULE 2010						
Treatment	**Application Date**	**MI**	**M2**	**M3**	**M4**	**M5**
A	**01/07/10**	02.08.10	02.09.10	01.10.10	01.11.10	01.12.10
B	**07/07/10**	06.08.10	03.09.10	05.10.10	05.11.10	06.12.10
C	**29/06/10**	02.08.10	02.09.10	01.10.10	01.11.10	01.12.10
D	**08/07/10**	06.08.10	03.09.10	05.10.10	05.11.10	06.12.10
Small Trees [5-19.9cm DBH] 40 trees/species/treatment= 320 Total						

As can be seen from the above tables rescheduling adjustments were necessary due to interruptions caused with cyclone clean up and re-census work required, as well as, bad weather prohibiting actual treatment. Furthermore

5. **INITIAL ANALYSIS:** As mentioned earlier a new data set (post cyclone *RENE*) was established to primarily to determine the extent of damage caused to the trial block in general and weather the effort could continue. The team focused on assessing the already chemically treated trees (large size class >20cm DBH) and weather a sufficient number of trees of both target species (*Castilla elastica* & *Funtumia elastica*) for the small size class (<20 cm DBH) remained in each treatment block (e.g. 40 trees each) or weather substitute trees needed to be found elsewhere within the trial block or even outside the immediate trial area. A general summary of this analysis can be found in the discussion on results below.

6. **TREATMENT IMPLEMENTATION (small trees >20cm DBH):** Once treatment trees were selected and sorted the implementation of chemical treatments could take place. Again the field team (e.g. Isamaeli Asotasi, Joe Pisi + 3 new casual hires) conducted the work in the field trial block over the 10 day period of June 28 - July 9, 2010. All the treatments required clear and "rain-free" weather for effective implementation therefore; close communications and "recognisance" with the local Meteorological Office and various internet weather websites were established. Each treatment required approximately a full 5 hours to complete and the actual treatments took place as follows:

   - **TREATMENT A (BLOCK 1) =** Triclopyr H&S [Hack & Squirt] RED PAINT LABEL = 07/01/2010 Approximate amount used (1.5 l/40 trees)
   - **TREATMENT B (BLOCK 2) =** Banvine H&S [Hack & Squirt] BLUE PAINT LABEL = 6/30/2010 Approximate amount used (1.8 l/40 trees)
   - **TREATMENT C (Block 3) =** Glyphosate H&S [Hack & Squirt] WHITE PAINT LABEL = 6/29/2010 Approximate amount used (1.8 l/40 trees)
   - **TREATMENT D (Block 4) =** Triclopyr B&B [Basal Bark Spray] RED PAINT LABEL = 07/09/2010 Approximate amount used (2.8 l/40 trees).

7. **PROJECT PURCHASES/HIRES [MNRE]:** The Principle Parks and Reserves Officer Mr. Su'emalo Talie Foliga organized for the hire of 3 casual workers and the purchase of the following materials and equipment:

TABLE 9: PROJECT PURCHASES

Item	Quantity	Cost/Unit/SAT	Total Cost	Comments
First Aid Kit	1	$135	$135.00	For safety of the workers
External Hard Drive	1	$530	$530.00	Back-up drive to store all the project data
Planter Bags	10,000	$0.30	$3000.00	Raising of enough seedlings for restoration work
Safety Boots	3	$210	$630.00	Safety boots to be worn by field staff working on the project
Spray Paint Blue Spray Paint White Spray Paint Red	4 4 4	$10.50 $16.75 $13.25	$42.00 $67.00 $53.00	Marking of trees being treated. Different colour code indicate type of chemical used
Nails (2") Nails (4") Nails (1.5")	6 lbs 4 lbs 5 lbs	$3.00 $3.00 $3.00	$18.00 $12.00 $15.00	Use for making signs and mounting of tree name tags
		TOTAL	**$12,812.00**	

8. **REPLANTING OF DAMAGED/DISTURBED AREAS ADJACENT TO TRIAL BLOCK:** The project arranged for the short-term hire of 3 casual workers to assist in completing the various tasks of the implementation plan including some replanting activities as was suggested in the earlier PHASE I (Bonin, as well as in later project committee meetings in PHASE II. These activities included:
   a. The collection, propagation, and bulking up of selected native lowland forest species (see discussion below) planting materials in the parks existing nursery;
   b. The establishment of a "on-site" fly nursery for the propagation and establishment of selected native species (see Plates and Table);
   c. The randomized replanting of target disturbed site (see Plates and Tables)

Suggested Restoration and Replanting Approach (Adopted from PHASE I Report Bonin, 2008): Whistler, 2002 explains rainforest structure in Samoa as being influenced by a complex array of environmental and bio-geographical factors which include: soil, topography, elevation, and degree of disturbance. Based on topography Whistler further defines five categories of lowland rainforests as coastal forests, valley forests, lava flow forests, ridge forests, and slope forests with additional subdivisions or "associations" made by identifying a using dominant species complex by genus e.g. *Diospyros* coastal forest.

Whistler, 2002 further suggests a complex of at least 35 major tree species representing at least 12 plant families in Samoan lowland forests ranging in elevation from 1-1,100m above sea level. Based on the results obtained from the transect blocks survey 24 out of the major lowland forest tree species are found in various numbers in the Mt. Vaea Reserve (see Table below).

TABLE 10: Important Samoan lowland tree species in the Mt Vaea reserve*				
Samoan Name	**English Name**	**Species Name**	**Relative Presence in Reserve****	**Propagation Methods Established*****
'O'a	?	*Bischofia javanica*	D	-
Tamanu	?	*Callophyllum neo-ebundicum*	D	X
Moso'oi	Perfume Tree	*Cananga odorata*	D	X
Maali	?	*Canarium vitiense*	D	X
Anume	?	*Diospyros elliptica*	D	-
Au'auli	Samoan Ebony	*Diospyros samoensis*	D	X
Maota/Tufaso	?	*Dysoxylum samoensis*	C	X
A'amati'e	?	*Elaeocarpus floridanus*	D	-
Pua lulu	?	*Fagraea berteroana*	D	-
Aoa	Banyan	*Ficus obliqua*	C	-
Ifi	Polynesian Chestnut	*Inocarpus fagifer*	C	-
Lau fatu / Lau pata	?	*Macaranga stipulosa*	D	-
Atone	Samoan Nutmeg	*Myristica inutilis*	A	X
Atone 'ulu	?	*Myristica hypargyraea*	D	-
Afa	?	*Neonauclea forsteri*	D	X
Gasu	?	*Palaquim stehlinii*	A	X
Ala'a	?	*Planchonella garberi*	D	X
Mamalava	?	*Planchonella samoensis*	D	X
Tava	?	*Pometia pinnata*	A	X
Tavai	?	*Rhus taitensis*	D	-
Fana'io	?	*Sterculia fanaiho*	D	-
Asi Vai	?	*Syzygium dealatum*	D	-
Asi Toa	?	*Syzygium inophylloides*	D	X
Malili	?	*Termnalia richii*	D	X
		24 Total Lowland Species	2/A, 3/C, 19/D	13 X

* = Species List adapted and based on Table 5.2 taken from Whistler, 2002

** = Based on number of plants counted in transect survey blocks: A=31+ plants; B= 21-30 plants; C=11-20 plants; D= 0-10 plants

*** = Based information and data taken from the draft Propagation Manual (Foliga and Blaffart 2007) (X = propagation methods established)

As can be seen from the species listed above and the species recorded from the plant survey (see Appendix) the Mt. Vaea Reserve is a complex association of mature secondary, secondary and primary forest canopy and sub-canopy species. A suitable replanting strategy should therefore, be based largely on this type of forest structure, maintaining as many of these species as possible while removing the undesirables. The following are some general suggestions offered for restoration work within the reserve:

- As soon as possible initiate nursery establishment and production of important species listed above focussing especially on species in short supply and/or with low numbers of seedlings recorded or observed throughout the reserve. *(Note: Some areas of the reserve were recorded as having considerable numbers of Tava Pometia pinnata scatted throughout the forest floor and would be a good source of planting material).*
- In some areas of the reserve treatment of other scrub under story species will no doubt be necessary for better quicker restoration to take place. Research should target this area first in order to identify the best methods (mechanical or chemical) for controlling these problem species (e.g. *Cestrum nocturnum* and *Ardessia elliptica*). Take action against these species at the same time as removal of invasive tree species.
- Attempt as best as possible to emulate a more natural or "gap succession" process (as discussed by Whistler, 2002) meaning scattered and partial removal of canopy with replanting occurring simultaneously in each of these areas. Over removal will only cause more problems.
- Utilize shade tolerant species in heavily infested areas to allow for quicker recovery (refer to propagation manual for complete details).

TABLE 11: NATIVE TREES REPLANTING SCHEME MT. VAEA ECOLOGICAL RESTORATION PROJECT PHASE II (JULY, 2010)					
Date	**Species Local Name**	**Scientific Name**	**Species Family Name**	**Total Number**	**Relative Presence in Reserve****
07.16.10	Tamanu	*Callophyllum neo-ebundicum*	Clusiaceae	58	D
	Fau	*Hibiscus tiliaceus*	Malvaceae	36	A
	Fanaio	*Sterculia fanaiho*	Sterculiaceae	18	D
	Mosooi	*Cananga odorata*	Annonaceae	20	D
	Maota	*Dysoxylum samoensis*	Meliaceae	12	C
			SUB TOTAL	**134**	-
07.20.10	Ifilele	*Intsia bijuga*	Fabaceae	40	None
	Manaui	*Gauga floribunda*	Burseraceae	6	reported
	Atone	*Myristica inutilis*	Myristicacea	38	A
	Auauli	*Diospyros samoensis*	Ebenaceae	25	D
	Mosooi	*Cananga odorata*	Annonaceae	19	D
			SUB TOTAL	**128**	-
07.21.10	Tamanu	*Callophyllum neo-ebundicum*	Clusiaceae	39	D
	Tava	*Pometia pinnata*	Sapindaceae	42	A
	Gasu	*Palaquim stehlinii*	Sapotaceae	28	A
	Mamalava	*Planchonella samoaensis*	Sapotaceae	10	D
	Asi Toa	*Syzygium inophylloides*	Myrtaceae	10	D
			SUB TOTAL	**129**	-
07.27.10	Tamanu	*Callophyllum neo-ebundicum*	Clusiaceae	30	D
	Asi Toa	*Syzygium inophylloides*	Myrtaceae	40	D
	Mosooi	*Cananga odorata*	Annonaceae	30	D
	Mamalava	*Planchonella samoaensis*	Sapotaceae	40	D
	Gasu	*Palaquim stehlinii*	Sapotaceae	60	A
	Ifilele	*Intsia bijuga*	Fabaceae	30	?
			SUB TOTAL	**230**	-
07.28.10	Ifilele	*Intsia bijuga*	Fabaceae	40	None
	Falaga	*Barringtonia samoensis*	Barringtoniaceae	40	C
	Tamanu	*Callophyllum neo-ebundicum*	Clusiaceae	40	D
			SUB TOTAL	**120**	-
07.29.10	Fanaio	*Sterculia fanaiho*	Sterculiaceae	50	D
	Tava	*Pometia pinnata*	Sapindaceae	50	A
	Fau	*Hibiscus tiliaceus*	Malvaceae	46	A
	Falaga	*Barringtonia samoensis*	Barringtoniaceae	60	C
	Mosooi	*Cananga odorata*	Annonaceae	47	D
	Gasu	*Palaquim stehlinii*	Sapotaceae	58	A
			SUB TOTAL	**311**	-
07.30.10	Tamanu	*Callophyllum neo-ebundicum*	Clusiaceae	28	D
	Asi Toa	*Syzygium inophylloides*	Myrtaceae	48	D
	Mosooi	*Cananga odorata*	Annonaceae	43	D
	Mamalava	*Planchonella samoaensis*	Sapotaceae	40	D
	Ifilele	*Intsia bijuga*	Fabaceae	40	None
	Tava	*Pometia pinnata*	Sapindaceae	50	A
	Fau	*Hibiscus tiliaceus*	Malvaceae	40	A
			SUB TOTAL	**289**	-
TOTALS	**13 SPECIES**		**TOTALS**	**1341**	-

** = Based on number of plants counted, recorded and/or observed in transect/observation survey blocks PHASE I:
A = 31+ plants; B = 21-30 plants; C = 11-20 plants; D = 0-10 plants

KEY FINDINGS OF PILOT STUDY: Since the Mt. Vaea Project's Initiation back in 2007 volumes of data and information has been discussed, collected, recorded and documented. The majority of this information is "scientific" in nature and as such it describes and attempts to quantify the whole Park Area in terms of its native biodiversity and need for restoration and protection from further degradation. Because of the nature of information obtained it was necessary to present this in complex tabular format for best understanding.

Species Composition of Trial Area: Despite the numerous setbacks and delays (some already discussed) initial results obtained from both the initial baseline data set collection during establishment and the actual field trial data that were obtained to date are worthly of noting here. (please note that small tree treatment trees will continue to be monitored for the remainder of this year). The trial block area itself contained a respectable number of native species (e.g.23 species)

and certainly had considerable numbers of introduced (e.g. 11 species) species and in particular the main target invasive species involved in the research. Introduced species represented a proportion of the species in the block (85%) with the 5 main target species being the largest in both number (12590 and percentage (79%) (see also TABLEs 12&13 below).

TABLE 12: SPECIES COMPOSITION [RE-CENSUS DATA] MT. VAEA TRIAL BLOCK (1 Hectare)

Species Count	Samoan Name	Scientific Name	Taxonomic Family	Plant Status Native vs. Exotic	No. Individuals Pre-Storm	No. Individuals Post-Storm	Total Deviation
1	Alaa	*Planchonella garberi*	Sapotaceae	Native	1	1	-
2	Atone	*Myristica inotilis*	Myristicacea	Native	70	68	-2
3	Asi vai	*Syzygium dealatum*	Mytaceae	Native	1	1	-
4	Fau	*Hibiscus tiliaceus*	Malvaceae	Native	68	66	-2
5	Filimoto	*Flacourtia rukam*	Flacourtiaceae	Native	12	9	-3
6	Fanaio	*Sterculia fanaiho*	Sterculiaceae	Native	3	6	+3
7	Faapasi	*Spathodea campanulata*	Bignoniaceae	Introduced	144 **[9.1%]**	144 **[9.5%]**	-
8	Fuafua	*Kleinhovia hospita*	Sterculiaceae	Native	7	7	-
9	Gasu	*Palaquim stehlinii*	Sapotaceae	Native	6	8	+2
10	Ifi	*Inocarpus fagifer*	Fabacea	Native	2	2	-
11	Koko	*Theobroma cacao*	Sterculiaceae	Introduced	3	3	-
12	Lagaali	*Aglaia samoensis*	Meliaceae	Native	1	1	-
13	Lopa	*Adenanthera pavonia*	Fabacea	Introduced	68	72	+4
14	Laupata	*Macaranga harveyana*	Euphorbiaceae	Native	7	5	-2
15	Maota	*Dysoxylum maota*	Meliaceae	Native	3	2	-1
16	Mahoki	*Swietenia macrophylla*	Meliaceae	Introduced	2	2	-
17	Maota mamala/Tufaso	*Dysoxylum samoensis*	Meliaceae	Native	7	9	+2
18.	Mati	*Ficus godeffoyi*	Moraceae	Native	0	2	+2
19	Mosooi	*Cananga odorata*	Annonaceae	Native	4	5	+1
20	Niu	*Cocos nucifera*	Arecaceae	Native??	3	2	-1
21	???? (None)	*Citronella samoensis*	Icacinaceae	Native	0	1	+1
22	Olioli	*Cyathea sp.*	Cyatheaceae??	Native??	9	8	-1
23	Pulu mamoe	*Castilla elastica*	Moraceae	Introduced	372 **[23.4%]**	323 **[21.3%]**	-49
24	Poumuli	*Flueggea flexuosa*	Euphorbiaceae	Introduced	6	6	-
25	Laupata	*Macaranga harveyana*	Euphorbiaceae	Native	2	5	+3
26	Puluvao	*Funtumia elastica*	Apocynaceae	Introduced	684 **[43%]**	662 **[43.6%]**	-22
27	Sita	*Cedrella odorata*	Meliaceae	Introduced	1	2	+1
28	Tava	*Pometia pinnata*	Sapindaceae	Native	25	22	-3
29	Tagitagi vao	*Polyscias samoensis*	Araliacea	Native	0	1	+1
30	Tamaligi paepae	*Albizia falcataria*	Fabacea	Introduced	13 **[0.8%]**	16 **[1.0%]**	+3
31	Tamaligi uliuli	*Albizia chinensis*	Fabacea	Introduced	46 **[2.9%]**	52 **[3.4%]**	+6
32	Toi	*Alphitonia ziziphoides*	Rhamnaceae	Native	2	2	-
33	Tavai	*Rhus taitensis*	Anacardiaceae	Native	2	2	-
34	Ulu	*Artocarpus altilis*	Moraceae	Introduced	14	14	-
			TOTALS	**Native=23**	**1590**	**1517**	**-73***
			34 Species	**Introduced=11**	Pre "*Rene*"	Post "*Rene*"	

= Additional key invasive species in study but were not chemically treated; **[%]** = percent of total number of trees counted in respective survey.

3= Species name was confirmed**

2= Treated

***= Treated trees (>20cm DBH) account for 71 or (97%) of missing trees.**

**= species required scientific name confirmation in original ID from first census data.

TABLE 13: MT.VAEA TRIAL TREATMENT BLOCK (1 ha.) RECENSUS SUMMARY DATA (Total Tree Numbers/ha./status)

Total Number Trees/Species	Native	Introduced	Introduced/Invasive	Totals
Changed/Damaged	**81 [5.3%]**	**8 [0.5%]**	**389 [25.6%]**	**478 [31.5%]**
Normal	**151 [9.9%]**	**18 [1.2]**	**818 [53.9%]**	**987 [65.1%]**
Treated	**0**	**0**	**51 [3.4%]**	**51 [3.4%]**
Totals	**232 [15.3%]**	**26 [1.7%]**	**1259 [83%]**	**1517**

Initial Trial Results Analysis: As mentioned earlier treatment monitoring records were taken in the field monthly and kept in separate excel worksheet (in the main database file) for easier statistical analysis. The following tables detail monitoring results obtained from the treated trees as of September 3, 2010 noting that the small tree monitoring has only two records and will continue till end of 2010. The scores given (i.e. 0-3) represent the subjective assessment of the field team. Again the agreed assessment classes and/or scores were based on symptoms observed in the field and are described as follows: [**O** = No sign of effect *(no effect of the chemical);* **1** = Slight sign of effect *(tree still looks active and alive; some small portions of leaves drying/turning yellow; bark appears active);* **2** = Strong sign of effect *(No leaves, top part dried but the wood and bark going down is partly drying and detaching);* **3** = Complete death *(no leaves, bark removed and moulds evidently present with tiny white organisms covering the wood)*]

TABLE 14: Pulu Mamoe *Castilla elastica* Treatment Results Large trees [>20cm] 40 (39) Trees total

Treatment	Block #	Tree #	Species	DBH	M1A	M2A	M3A	M4A	M5A	M6A	M7A	M8A
A	1	483	PM	46	2	2	2	3	3	3	3	3
A	1	777	PM	37.8	2	2	2	3	3	3	3	3
A	1	143	PM	33.2	2	3	3	3	3	3	3	3
A	3	552	PM	33	2	2	2	3	3	3	3	3
A	3	314	PM	34.4	2	2	2	3	3	3	3	3
A	1	757	PM	29.2	2	2	2	3	3	3	3	3
A	1	144	PM	23.8	2	3	3	3	3	3	3	3
A	3	282	PM	15.2	2	2	3	3	3	3	3	3
A	3	320	PM	20.1	2	2	3	3	3	3	3	3
A	3	279	PM	23	2	2	2	3	3	3	3	3
			TOTALS	**295.7**	**20**	**22**	**24**	**30**	**30**	**30**	**30**	**30**
B	2	1475	PM	45.3	2	2	2	3	3	3	3	3
B	2	1513	PM	55.8	2	0	0	0	0	0	0	1
B	2	1468	PM	73.5	2	1	2	3	3	3	3	3
B	2	824	PM	37	3	2	2	3	3	3	3	3
B	2	1478	PM	74.6	2	3	3	3	3	3	3	3
B	2	1460	PM	28.7	2	2	2	3	3	3	3	3
B	2	1182	PM	21	2	2	2	3	3	3	3	3
B	2	1223	PM	33	2	2	2	3	3	3	3	3
B	2	1184	PM	47.8	2	2	2	3	3	3	3	3
B	2	1231	PM	35.8	3	3	2	3	3	3	3	3
			TOTALS	**452.5**	**19**	**19**	**19**	**27**	**27**	**27**	**27**	**28**
C	3	8	PM	46.8	1	1	1	1	0	0	0	0
C	3	588	PM	41.3	2	2	2	2	3	3	3	3
C	3	644	PM	38.6	1	1	1	2	3	3	3	3
C	3	628	PM	34.7	1	1	0	1	0	0	0	2
C	3	560	PM	20.9	1	1	1	1	0	0	0	1
C	3	29	PM	39.2	2	1	2	3	3	3	3	3
C	3	245	PM	20	2	2	2	3	3	3	3	3
C	3	619	PM	23.3	2	2	2	3(2)	3(2)	3(2)	3(2)	2
C	3	2	PM	8.6	1	2	1	1	0	0	0	1
			TOTALS	**273.4**	**13**	**13**	**12**	**17(16)**	**15(14)**	**15(14)**	**15(14)**	**18**
D	4	1343	PM	47	X	X	1	1	1	1	1	0
D	4	1565	PM	18.7	X	X	2	2	2	2	2	3
D	4	1081	PM	18.5	X	X	1	1	1	1	1	3
D	X	M1	PM	34.1	X	X	2	2	2	3	3	3
D	X	M2	PM	36.8	X	X	2	2	2	3	3	3
D	X	M3	PM	38.7	X	X	2	2	2	3	3	3
D	X	M6	PM	26.1	X	X	2	2	2	3	3	3
D	X	M7	PM	26.5	X	X	3(2)	2	2	3	3	3
D	X	M8	PM	35.5	X	X	3(2)	2	2	3	3	3
D	X	M9	PM	23.9	X	X	2	2	2	3	3	3
			TOTALS	**305.8**	**X**	**X**	**20(18)**	**18**	**25**	**25**	**25**	**27**

Colour Codes: RED = Triclopyr treatments blocks A&D; **BLUE** = Banvine treatment block B; **WHITE** = Glyphosate treatment block C;
GREY = Substitute trees used in different blocks and/or area to make up sufficient tree numbers for treatment; **(#) = Readjusted**.

TABLE 15: PULU MAMOE [LARGE TREES] TREATMENT MONITORING CUMULATIVE SCORES

TREATMENT	MEAN DBH	M1A	M2A	M3A	M4A	M5A	M6A	M7A	M8A
A (n=10)	**29.6**	20	22	24	30	30	30	30	30
B (n=10)	**45.2**	19	19	19	27	27	27	27	28
C (n=9)*	**30.4**	13	13	12	17	15	15	15	18
D (10)	**30.6**	X	X	20	18	25	25	25	27

*= only 9 trees in data set

TABLE 16: Pulu Vao (*Funtumia elastica*) Treatment Results Large Trees [>20cm] 24 Trees Total												
Treatment	**Block #**	**Tree #**	**Species**	**DBH**	**M1A**	**M2A**	**M3A**	**M4A**	**M5A**	**M6A**	**M7A**	**M8A**
A	1	735	PV	33.1	0	1	1	1	1	1	1	2
A	1	745	PV	26	0	1	1	1	1	1	1	3
A	1	481	PV	23	0	1	1	1	1	1	1	2
A	1	731	PV	22.1	0	1	1	1	1	1	1	2
A	1	707	PV	21.9	0	1	1	1	1	1	1	2
A	1	373	PV	21	0	1	1	1	1	1	1	1
			TOTALS	**126.1**	**0**	**6**	**6**	**6**	**6**	**6**	**6**	**12**
B	4	1339	PV	38.1	2	1	1	1	1	1	1	1
B	2	879	PV	28.8	0	1	1	0	0	0	0	0
B	2	1141	PV	22	0	3	3	3	3	3	3	3
B	2	1085	PV	20.9	1	1	1	1	1	1	1	3
B	4	962	PV	20	0	1	1	3	3	3	3	3
B	4	987	PV	20.4	1	3	3	3	3	3	3	3
			TOTALS	**150.2**	**4**	**10**	**10**	**11**	**11**	**11**	**11**	**13**
C	X	V4	PV	20.6	2	2	2	3	3	3	3	3
C	X	V5	PV	25	2	2	2	3	3	3	3	3
C	3	567	PV	20.4	2	1	1	2	2	2	2	3
C	3	633	PV	30.2	2	1	1	2	2	2	2	3
C	4	887	PV	27.8	2	2	2	3(2)	2	2	2	2
C	4	1333	PV	27.4	2	2	2	2	2	2	2	3
			TOTALS	**123.6**	**12**	**10**	**10**	**15(14)**	**14**	**14**	**14**	**17**
D	4	942	PV	22.2	X	X	1	1	1	1	1	1
D	4	980	PV	22.2	X	X	1	1	1	1	1	2
D	4	1344	PV	25.3	X	X	1	1	1	1	1	1
D	X	V1	PV	23.1	X	X	0	0	1	1	1	3
D	X	V6	PV	23	X	X	0	0	1	1	1	3
D	X	V7	PV	23.4	X	X	0	0	1	1	1	3
			TOTALS	**139.2**	**X**	**X**	**3**	**3**	**6**	**6**	**6**	**10**
Pulu Vao *Funtumia elastica* Large Trees [>20cm] 24 trees total												

Colour Codes: RED = Triclopyr treatments blocks A&D; **BLUE** = Banvine treatment block B; **WHITE** = Glyphosate treatment block C; **GREY** = Substitute trees used in different blocks and/or area to make up sufficient tree numbers for treatment; **(#) = Readjusted**.

TABLE 17: PULU VAO [LARGE TREES] TREATMENT MONITORING CUMULATIVE SCORES 2010									
TREATMENT	**MEAN DBH**	**M1A**	**M2A**	**M3A**	**M4A**	**M5A**	**M6A**	**M7A**	**M8A**
A (n=6)	**21.0**	0	6	6	6	6	6	6	12
B (n=6)	**25.0**	4	10	10	11	11	11	11	13
C (n=6)	**20.6**	12	10	10	15	14	14	14	17
D (n=6)	**23.2**	X	X	3	3	6	6	6	10

Small tree results analysis was much the same as for the large trees of both species with the exception that the tree numbers/treatment were consistent amongst all treatments and greater in total number (n=40). Furthermore, there was less need for substitute trees to be used as small size class trees of both species were generally sufficient within all blocks. A summary of the cumulative scores for 2 monitoring dates are as follows:

TABLE 18: PULU MAMOE [SMALL TREES] TREATMENT MONITORING CUMULATIVE SCORES									
TREATMENT	**MEAN DBH**	**M1A**	**M2A**	**M3A**	**M4A**	**M5A**	**M6A**	**M7A**	**M8A**
A (n=40)	**8.4**	115	117						
B (n=40)	**11.5**	93	96						
C (n=40)*	**13.4**	119	124						
D (n=40)	**8.9**	98	98						

*= only 9 trees in data set

TABLE 19: PULU VAO [SMALL TREES] TREATMENT MONITORING CUMULATIVE SCORES									
TREATMENT	**MEAN DBH**	**M1A**	**M2A**	**M3A**	**M4A**	**M5A**	**M6A**	**M7A**	**M8A**
A (n=40)	**12.2**	41	34						
B (n=40)	**12.7**	39	34						
C (n=40)	**10.0**	101	81						
D (n=40)	**10.6**	40	36						

Results Discussion: On September 2, 2010 members of the team and committee met and discussed the trial results achieved thus far. The group was joined by Mr. Tilafono David Hunter of USP, Alafua School of Agriculture whom was assisting the group in statistical analysis of the trials data set at the request of the Technical Advisor/Consultant. David

explained some of the basic tests and methods available for analysis of such type of data and also pointed out some of the limitations that may confound the statistics. Mr. Hunter used the statistical software package (GenStat) and employed statistical tests suitable to the type of data obtained (i.e. ordinal) and therefore, used tests suitable for use in ranking type data (i.e. a ranking of chemical effect) such as that collected by this particular field trial. Non-parametric statistics were necessary for such a type of data which included the use of median as the measure of a central tendency and non-parametric analysis of variance. For the Mt. Vaea dataset Mr. Hunter used the Kruscal-Wallis One-Way Analysis of Variance test and the Analysis of an unbalanced design using Gen Stat regression. Mr. Hunter further described the approach to this analysis as follows:

a) The two datasets were sorted by tree species first and then by treatment. An essential requirement (major assumption) of any statistical test, in this case, the Kruskal-Wallis test to compare the severity of damage caused by the four treatments A, B, C and D, is that the two tree species (Pulu Mamoe and Pulu Vao) are randomly selected and assigned to the four experimental treatments. This did not appear to be the case as per trial layout that was provided. Therefore caution must be exercised if the analysis results are going to be used for recommendation purposes outside of the reserve area.
b) Within each invasive tree, the mean DBH values and median severity values (not mean values) of damage caused by the four treatments were calculated to compare between the four treatments. Given that the scale used was 0-3 (i.e. 0 = no effect; 1 = slight effect; 2 = strong effect; 3 = complete death) used for qualitative assessment of severity of damage would not have resulted in a normal distribution, the medians instead of the means were used and the non-parametric equivalent of a one-way analysis of variance for a completely randomized design, called the Kruskal-Wallis test was used. The problem with both methods is that they still require that the trees be randomly selected to receive the four treatments but this was not so.
c) The interpretation of the Kruskal-Wallis test (two-way unbalanced analysis) employed is as follows: if the χ^2 probability <0.05, then there are likely real differences between the four experimental treatments. Otherwise, there are no differences.

The team discussed the overall limitations in the present data and results to date especially given the interruptions in applications (i.e. cyclone re-census work and weather delays) and the "true " amount of time transpired since initial application for some of the treatment trees (i.e. block D). This concern was particularly true for the small tree treatments which had only 3 months since chemical application occurred.

Furthermore, due to the subjective ranking method used in the field trial assessment human error was a potential contributing factor which could confound results and their interpretation. In some of the tables presented some of the assessment scores were indicating a trees recovery from an earlier record and while it cannot be ruled out for a slight sign to revert back it was seen as impossible to recover from a score of complete death. Mr. James Atherton pointed this error out and suggested that those particular scores be re-adjusted and offered to assist again with a pivot table analysis and establishing some graphical presentations of these results (see also Figures E &F). James also pointed out that he had experienced that signs of death in trees (*Spathodea campanulata*) he had treated sometimes took as long as 6 months before symptoms appeared and suggested the project continue to collect monitoring result for all treatment and size classes at least till the end of the year. Generally speaking results indicated that most all treatments had some effect on both target species 8 months after application. However, major differences were observed between the two species particularly in the level of efficacy of each chemical over time. Chemical treatment of Pulu Mamoe (*Castilla elastica*) started to have a serious effect on large trees 4 months after treatment particularly for treatments A and B (Triclopyr and Banvine respectively). Pulu Vao (*Funtumia elastica*) on the other hand has proven to be far more difficult and much slower to respond to all treatments so far (Tables) with treatment C (Glyphosate) leading in month 8.

TABLE 20: Percentage Complete Death PULU MAMOE LARGE/Treatment/Month

Item/Month	M1	M2	M3	M4	M5	M6	M7	M8
Count A	*0*	*2*	*4*	*10*	*10*	*10*	*10*	*10*
Treatment A%	**0**	**20**	**40**	**100**	**100**	**100**	**100**	**100**
Count B	2	2	1	9	9	9	9	9
Treatment B%	**20**	**20**	**10**	**90**	**90**	**90**	**90**	**90**
Count C	*0*	*0*	*0*	*2*	*4*	*4*	*4*	*4*
Treatment C%	**0**	**0**	**0**	**22**	**44**	**44**	**44**	**44**
Count D	*0*	*7*	*7*	*0*	*0*	*0*	*0*	*0*
Treatment D%	**0**	**70**	**70**	**0**	**0**	**0**	**0**	**0**

A= Triclopyr H&S (22.12.09) **RED PAINT; B=** Banvine H&S (22.12.09) **BLUE PAINT;**
C= Glyphosate H&S (16.12.09) **WHITE PAINT; D=**Triclopyr + diesel B&B (26.02.10) **RED PAINT**

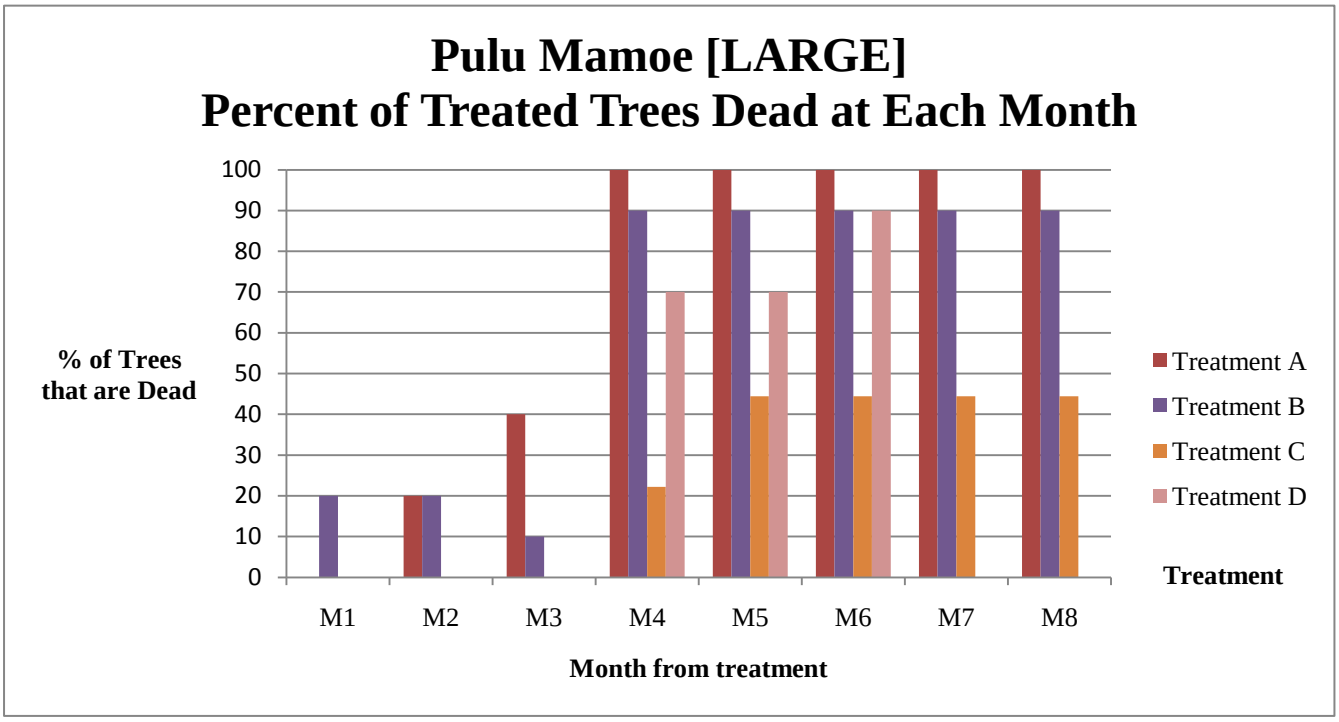

TABLE 21: Percentage Complete Death PULU MAMOE SMALL/Treatment/Month								
Item/Month	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**
Count A	*37*	*39*	***??***	***??***	***??***	***??***	***??***	***??***
Treatment A%	**92.5**	**97.5**	**??**	**??**	**??**	**??**	**??**	**??**
Count B	*9*	*16*	***??***	***??***	***??***	***??***	***??***	***??***
Treatment B%	**22.5**	**40**	**??**	**??**	**??**	**??**	**??**	**??**
Count C	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*
Treatment C%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Count D	*18*	*18*	***??***	***??***	***??***	***??***	***??***	***??***
Treatment D%	**45**	**45**	**??**	**??**	**??**	**??**	**??**	**??**

A= Triclopyr H&S (22.12.09) **RED PAINT; B=** Banvine H&S (22.12.09) **BLUE PAINT;**
C= Glyphosate H&S (16.12.09) **WHITE PAINT; D=**Triclopyr + diesel B&B (26.02.10) **RED PAINT**

TABLE 22: Percentage Complete Death PULU VAO LARGE/Treatment/Month								
Item/Month	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**
Count A	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*
Treatment A%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17**
Count B	*0*	*2*	*2*	*3*	*3*	*3*	*3*	*4*
Treatment B%	**0**	**33**	**33**	**50**	**50**	**50**	**50**	**67**
Count C	*0*	*0*	*0*	*2*	*2*	*2*	*2*	*5*
Treatment C%	**0**	**0**	**0**	**33**	**33**	**33**	**33**	**83**
Count D	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*
Treatment D%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**50**

A= Triclopyr H&S (22.12.09) **RED PAINT; B=** Banvine H&S (22.12.09) **BLUE PAINT;**
C= Glyphosate H&S (16.12.09) **WHITE PAINT; D=**Triclopyr + diesel B&B (26.02.10) **RED PAINT**

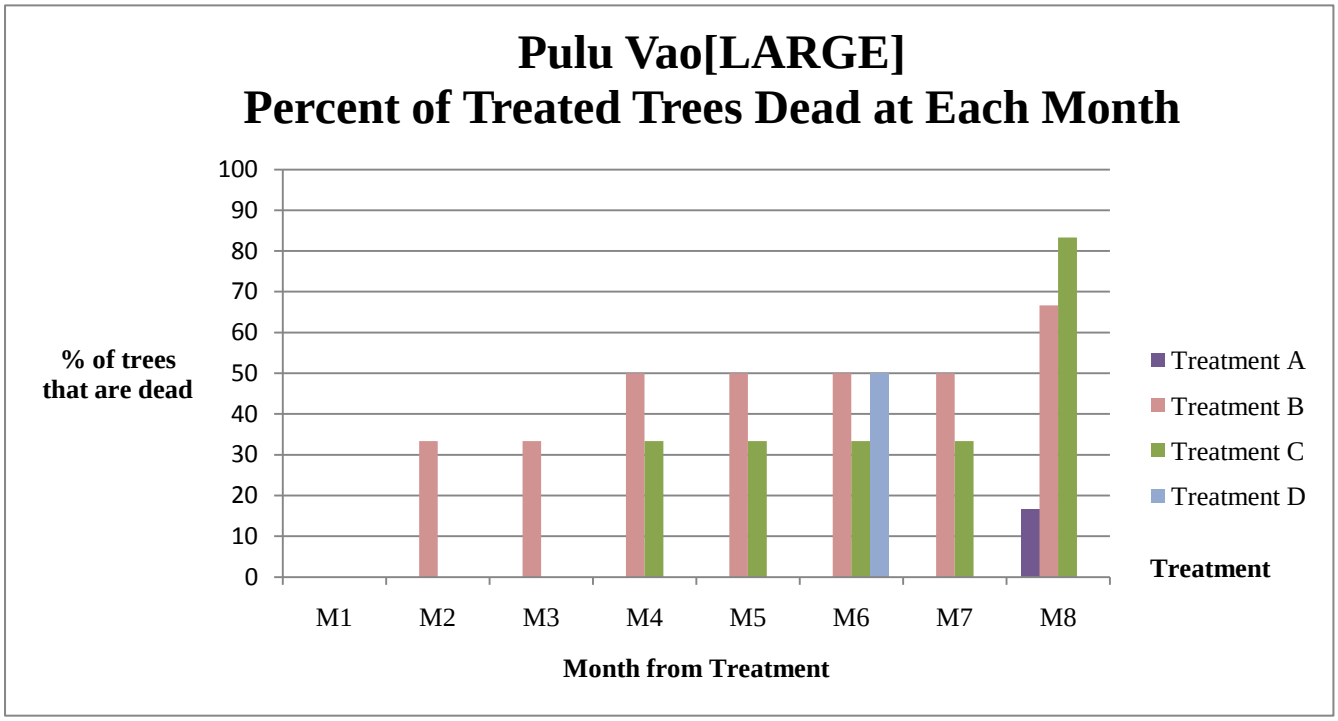

TABLE 23: Percentage Complete Death PULU VAO SMALL/Treatment/Month								
Item/Month	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**
Count A	*0*	*0*	*??*	*??*	*??*	*??*	*??*	*??*
Treatment A%	**0**	**0**	**??**	**??**	**??**	**??**	**??**	**??**
Count B	*0*	*0*	*??*	*??*	*??*	*??*	*??*	*??*
Treatment B%	**0**	**0**	**??**	**??**	**??**	**??**	**??**	**??**
Count C	*0*	*1*	*??*	*??*	*??*	*??*	*??*	*??*
Treatment C%	**0**	**2.5**	**??**	**??**	**??**	**??**	**??**	**??**
Count D	*0*	*0*	*??*	*??*	*??*	*??*	*??*	*??*
Treatment D%	**0**	**0**	**??**	**??**	**??**	**??**	**??**	**??**

CONCLUSIONS: The erosion of our natural bio-diversity especially in island ecosystems is often attributed to the incursion of invasive species and human exploitation. Given the present rate of globalization, the number of naturalized introduced plants and animals currently equals or even exceeds the number of native and endemic species in many tropical islands. Some of the naturalized plants have extended their distribution ranges and abundance with significant impacts on both species composition and ecosystem normal services and functions. The understanding of invasion patterns and processes is often a prerequisite for alien species management, endangered species conservation and habitat restoration thus the initiation of this major project in Samoa. The Mt. Vaea Project in its initial phases has been quite successful in establishing a platform for "ground breaking" field research and has established a significant database for sound invasive species management within the reserve. The overall understanding of the native biodiversity (both plant and animal) and of course the identification and assessment of the key invasive species within the reserve has increased tenfold. During each phase this continues to be brought up to date. This initial research and survey results painted a poor picture of overall forest health with the impacts of invasive species (both plant and animal) being evident and obvious throughout the whole reserve area.

The ecological restoration of Mt. Vaea Reserve will be a long, difficult and expensive task but certainly achievable provided adequate and sustainable resources are available for the continued work. The initial work plan proposed in the PHASE I report (2007) covered a 5 year period and an estimated cost of $700,000ST. Now when considering the scope of the work involved in the restoration of Mt. Vaea and increased costs of material and human inputs a longer period with additional resources will most likely be required. The fostering of corporate relationships and key partnerships to assist in technical and material expenses will no doubt be necessary. Possible donors will hopefully appreciate the magnitude of such an undertaking and be willing to enjoy the benefits of such a "ground breaking" endeavour. Therefore, it is sincerely hoped that many will want to participate in the projects future for many years to come.

RECOMMENDATIONS FOR FURTHER WORK: Successful ecological restoration work of this type has been done in very few places around the world and especially within the Pacific region. Samoa will most certainly be "breaking new ground" as far as the Pacific Islands are concerned. As mentioned earlier in searching for specific information on control methodologies for the project areas worst invasive plants, very little was found however, some appropriate literature

regarding restoration work was found based on experiences in Australia and are worthy of mention here. Some basic principles and useful guides to the continued work toward the Mt. Vaea Reserve ecological/forest restoration are as follows:

Work from areas of native plants (good areas) towards weed infested areas (bad areas): *Note-while the distribution of the top 5 target species appears very widespread there are some areas which are slightly less impacted and may be good starting points (e.g. Zone proposed for year 1).*
Make minimal disturbance to the area: *Note-This will be very difficult in the Mt. Vaea Project area as steep slopes and large invasive trees will inevitably cause damage if trees are felled and/or fall due to natural disturbances Thus making chemical methods with a slow but sure plant death a much more attractive option of removal.*
Let native plant regeneration dictate to rate of removal: *Note-This remains an unknown for now but continued monitoring of treatment blocks as well as, progress made in re-planted areas should provide some solid answers here. However, special attention should be given to reinvasion of other potentially serious invasives which may hamper native regeneration naturally. The degree of clearing and removal will by necessity require further study and observation but as a general suggestion/rule it is better to under-clear than to over-clear an area. Planned/ randomized plantings may be the best option in many areas of the reserve.*
Develop a zone based action plan: *Note-This will serve to guide all the field crew(s) in conducting the work throughout the 5 year period. For each year a block should be designated as a management zone starting from the best forest and moving toward the worst. An example would be as follows: (also see Figure G below).*

i. Zone: Year 1 = 9.4 ha. Work area
ii. Zone: Year 2 = 18.1 ha. Work area
iii. Zone: Year 3 = 19.1 ha. Work area
iv. Zone: Year 4 = 15.9 ha. Work area
v. Zone: Year 5 = 16.8 ha. Work area

Be wary of heavy disturbance to fragile soils on steep slopes: *Note-Attempt to maintain as much canopy cover and mulch (protection) as possible in order to prevent potential serious sheet and rill erosion.*
Protect native species when and wherever you can. *Note-Due this at all costs, they will help you win the war so know them well and understand the differences between your friends and your enemies.*
Be patient as the impact of control methods will take time. *Note-Results thus far have already illustrated this so it is fair to assume that the restoration and regeneration of native species will also take longer than anticipated.*
Take caution in the removal of species especially in heavily infested blocks. *Note- Scattered removal of a percentage of trees (say 30%) will be better for the forest restoration in the long run than complete removal. Therefore some areas will need to be treated more than once over the 5-10 year cycle.*

GENERAL RECOMMENDATIONS: In addition to what has already been suggested the following section lists some final ideas and suggestion points made throughout the trial phase and especially in more recent committee meetings: an d discussions.

1. Continue to monitor and record information from all trial blocks treatments as appropriate till at least end of year (as was agreed) and until another review can take place for confirming results and planning.
2. Future trials of such nature (i.e. perhaps testing Garlon 4 Ultra as originally planned) should employ a minimum 30 randomly selected test trees/treatment with a range of available size classes but not focussing on size as was done in this trial.
3. As soon as the anticipated funding from GEF PAS and the JICA Regional project (estimated March-April 2011) initiate a management phase with a team leader/advisor to oversee field operations and expenditures for the long haul. Buy a new computer with excellent antivirus software and communications capabilities.
4. Please keep, maintain and verify records at all times as human error is a fact of nature (we have proven that a thousand times) let someone else check your data input and entry.
5. Backup, backup, backup all data entries.....yours or someone else's blood sweat and tears has made it happen so please show it the respect it deserves! Once lost it is lost for good!!!!!!!!!!!!

Acknowledgements: I wish to thank JICA, MNRE, Project Committee, Funding Partners, and especially the field team for all the hard efforts that have made this all possible and the opportunity to do so. This has been a most interesting and challenging project and journey to remember. Its' certainly a first for Samoa and therefore truly hope for its ultimate success.

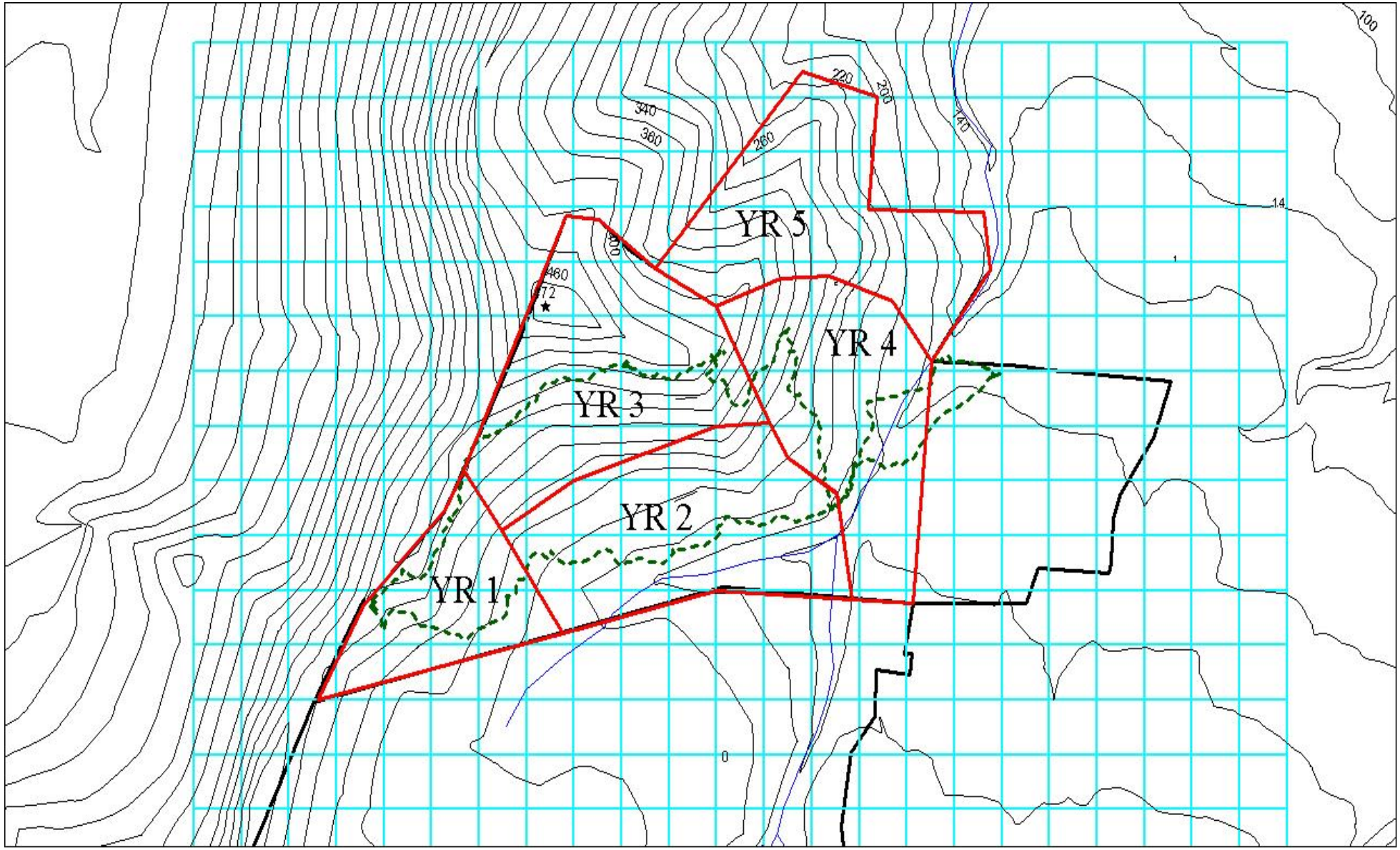

FIGURE G: SUGGESTED MANAGEMENT APPROACH FOR RESTORATION WORK

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ANNEX A: [CONTRACT TOR]

Mt. Vaea Ecological Restoration Pilot Trial (Phase III) APRIL 14 – SEPTEMBER 3, 2010

TERM OF REFERENCE FOR PROJECT TECHNICAL ADVISOR

The Technical Advisor (TA) will be responsible for advising, training and coordinating the project team for the successful implementation of the pilot trial phase of the Mt. Vaea Ecological Restoration Project. The trial will focus on the management of 1.5 hectares of forest including research on different management techniques to control priority invasive weeds and replanting with selected native species.

The TA will work closely with the staff of DEC, JICA, SPREP and CI to develop and monitor the implementation plan and research methodology for the trial project. The implementation plan will include a detailed costing of materials and equipment plus the timeline and schedules of each activity. He or She will be also responsible for the management of data collected throughout the pilot project and for coordinating training of project staff.

Project Team: The TA will working very closely with a project team of DEC staff that includes a Project Manager and other relevant DEC staff. The Project Manager will supervise the actual work in the reserve area while the TA will provide the technical advice for the work to be designed and conducted successfully and safely.

Project Committee: The TA will report to a Project Committee who will provide support and guidance for the implementation of the project. The project committee consists of membership from CI, SPREP, DEC and JICA and will meet on an ad hoc basis as required and requested by the TA and the Project Manager.

SPECIFIC TASKS: For all tasks conducted the TA will work closely with the Project Manager, but will take on the lead advisory role.

1. Formulate a 5 month implementation plan including budget plan for the established one hectare trial plot including the completion of all remaining treatments and specific data collection/monitoring tasks to be conducted by designated MNRE staff (April 2010 until September 2010).
2. Clearly define the types of data to be collected from the trial and develop data management protocols to be used and continue to coordinate, monitor and train project staff on the protocols as necessary.
3. Collect, verify, analyze, manage and present all data obtained during consultants input from the project.
4. Prepare final report on consultants input April- September, 2010.

DELIVERABLE OUTCOMES:

Data Management: The Project Technical Advisor will be also responsible for data management of this project. He/she can identify the types of data to collect and the mechanism to use for data collection and data processing.

Duration: The remainder of the project trial phase will last for 5 months (April-September, 20101) and is expected to be completed by September 3, 2010. The Technical Advisor will be employed for 24 days at SAT625 per day contract and will be based on the following schedule. (1).Three months at approximately 2 days per week. Starting effectively April 14, 2010 and completing September 3, 2010.

Responsible To: The TA is responsible to the Project Committee and to JICA who will be the main source of funding for this component of the trial.

Reporting: The TA with the assistance of the Project Manager will prepare regular progress reports during the project as defined in the implementation work plan.

Funded By: The TA position will be funded by JICA as part of its project of "Enhancing Management Capacity for Samoa's National Parks and National Reserve"

Schedule for Payments: Total Contract (24days x SAT625)	**=**	**SAT15, 000**
20% upon signing of contract and commencement of full implementation plan		=SAT 3,000
20% upon approval of submitted implementation plan		=SAT 3,000
20% after completion of all trial treatments and data collection identified in plan		=SAT 3,000
40% Data Management and Reporting		=SAT 6, 000
	Total	**=SAT 15, 000**

PROPOSED WORKPLAN PROJECT TECHNICAL ADVISOR MT. VAEA ECOLOGICAL RESTORATION PILOT TRIAL				
Specific Tasks	**Number of days and Timeline**	**Key Activities**	**Expected Outcomes**	**Payment Schedule**
Formulate a 5 month implementation plan for the established 1.5 hectare trial plot including the completion of all remaining treatment and data collection/monitoring tasks	8 days	Consult with Project Committee and Project Manager and field staff and finalize implementation work plan for remainder of trial phase.	▪ Commencement of Contract ▪ Implementation Plan developed and Approved by Project Committee	Initial payment 20% of total contract ($3,000) upon signing of contract. Invoice 1 Payment 20% contract ($3,000)
Clearly define the types of data to be collected from the trial and the data management protocols to be used and continue to train project staff on the protocols	6 days	▪ Coordinate and ensure accurate data collection ▪ Construct appropriate data management system • Collate and analyze data set for development of final recommendations.	▪	Invoice 2 Payment 20% contract ($3,000)
Collect, verify, analyze, manage and present all data obtained during consultants input from the project. Prepare final report on consultants input April-September, 2010.	10 days		▪ Final report including recommendations for future efforts submitted and approved.	Invoice 3 Final Payment 40% contract ($6,000)
TASKS 1-4 in TOR	**Total 24 days**	**As above**	**As above**	**Total $15,000 SAT**

Number of General Conditions Clause	**Supplements to Clauses in the General Conditions**
2.1	Contractual period: May 14th 2010 – September 2010
4.1	The Contract Price is WST 15,000 in total
4.2	The payment schedule and conditions are: ▪ 20% (WST 3,000) upon signing of contract and commencement of full implementation plan [INVOICE #1 May 19, 2010] ▪ 20% (WST 3,000) upon approval of submitted implementation plan [INVOICE #1 May 19, 2010] ▪ 20% (WST 3,000) after completion of all trial treatments and data collection identified in plan ▪ 40% (WST6,000) after the completion of data management and reporting
5.1	The Contractor's Specified Personnel [is/are]: 3M's Enterprises Ltd. Mr. Leatigaga Mark J. Bonin
6.1	The JICA Project Officer is: Mrs. Naoko Laka, Project Formulation Adviser, JICA
23.1	The Contractor's address for notices and the authorized representative is: **Mr. Leatigaga Mark J. Bonin** Managing Director/Principle Consultant 3M's Enterprises Ltd. PO Box 3039 Apia Tel: 21860 Fax: 25177 E-mail: bonin@lesamoa.net **JICA's address for notices and the authorized representative is:** **Mr. Manabu AIBA** Resident Representative Japan International Cooperation Agency PO Box 1625 Beach Road Mulivai, Apia Tel: 22572 or 22139 Fax: 22194

ANNEX B: [Implementation Plan]

Final Trial Phase Implementation Plan May 14-September 3, 2010			
Time Phase	**Main Activities**	**Status**	**Individuals Responsible**
May 14 - May 31	▪ Consult and meet with project committee in several meetings and discuss trial options post-cyclone *RENE* damage.	-Completed	-TA and Project committee
	▪ Re-assess whole trial block develop a new post-cyclone data base and identify extent of damage to all key (treatment) species trees	-Completed	-Field assessment conducted by Talie and field team and re-inputted, verified and reviewed by committee.
	▪ Develop and agree on strategy for the way forward with committee after review of data (committee meeting)	-Completed	-TA and Project committee
	▪ Continue to monitor and collect results data on treatment trees (large size class) Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
	▪ Sign contract and submit implementation plan discussed and designed in meeting 11.05.10	-Completed on 14.05.10	-HQ JICA Samoa, TA and Talie
	▪ Order and procure necessary materials and equipment already identified in the financial plan and arrange for the hire of casual labourers for project approved in budget plan meeting 7.05.10	-In Progress and approved in meeting 7.05.10	-HQ JICA Samoa and MNRE and Parks Senior and project staff (e.g. Talie and field team)
	▪ Continue to monitor and collect data on treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
	▪ Initiate treatment of small size class trees for treatment blocks A-D and identify & label substitute trees necessary for all treatments.	-Completed as Planned	-Senior Field Staff and crew
June 1 – June 14	▪ Initiate treatment of small size class trees for treatment blocks A-D and identify & label substitute trees necessary for all treatments.	-Completed as Planned	-Senior Field Staff and crew
	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
	▪ Draft data set protocols for discussion and approval in committee meeting	-Continuous / On-going	-TA and Project committee
June 15 - June30	▪ Complete all treatments of small size class trees for treatment blocks A-D and identify, label and map all substitute treatment trees for follow-up monitoring.	**COMPLETED as Planned June28-July9**	-Senior Field Staff and crew
	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
July 1 – July 15	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
July 15 – July 31	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
Aug. 1 – Aug. 14	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
Aug. 15 – Aug 30	▪ Continue to monitor and collect data on all treatment trees Blocks A-D	-Continuous / On-going	-Senior Field Staff and crew
	▪ Collect all final data set for analysis and reporting	-Planned	
Aug. 30-Sept. 3	▪ Analyze final data set and trial results and formulate recommendations and detail in final report as stipulated in TOR. Submit report	-Continuous / On-going /In progress	-TA and Senior Field Staff and crew

*Committee meetings have been held on April 7, 22, May 11, and June 15, 29, 2010

Submitted by Mark Bonin Date: May 19, 2010

Approved by: _____ Date: May 19, 2010
Sue'malo Talie Foliga

Assistance and statistical advice in data analysis was provided by David Hunter of USP Alafua = Yellow Highlight

ANNEX C: CHECKLIST OBSERVED/RECORDED PLANT SPECIES MT. VAEA PROJECT AREA
TRANSECT SURVEY RESULTS 2007-2008

Record No.	Samoan Name(s)	English Name(s)	Scientific Name	Plant Type	Plant Status*	
1	Lopa	Red-bead Tree	*Adenanthera pavonia*	Tree	INT/INV	
2	Laga'ali	?	*Aglaia samoensis*	Tree	NAT	
3	Tamaligi Uliuli	Albizia	*Albizia chinensis*	Tree	INT/INV	
4	Tamaligi Pa'epa'e	Albizia	*Albizia falcataria*	Tree	INT/INV	
5	Toi	?	*Alphitonia ziziphoides*	Tree	NAT	
6	Togovao	Shoebutton	*Ardessia elliptica*	Shrub	INT/INV	
7	Ulu	Breadfruit	*Artocarpus altilis*	Tree	INT	
8	Maniuniu	Palm (?)	*Balaka sp.*	Palm	NAT	
9	Falaga	?	*Barringtonia samoensis*	Tree	NAT	
10	O'a	?	*Bischofia javanica*	Tree	NAT	
11	Tamanu	?	*Callophyllum neo-ebundicum*	Tree	NAT	
12	Moso'oi	Perfume Tree	*Cananga odorata*	Tree	NAT	
13	Maali	?	*Canarium vitiense*	Tree	NAT	
14	Esi	Papaya	*Carica papaya*	Tree	INT	
15	Pulu Mamoe	Mexican Rubber Tree	*Castilla elastica*	Tree	INT/INV	
16	Sita	Ciga box cedar	*Cedrella odorata*	Tree	INT	
17	Alii o le po Teine o le Po	Night Cestrum	*Cestrum nocturnum*	Shrub	INT/INV	
18	Tigamoni	Cinnamon	*Cinnamomum verum*	Tree	INT	
19	?	?	*Citronella samoensis*	Tree	NAT	
20	Losa Honolulu	Honolulu Rose	*Clerodendrum philippinum*	Shrub	INT/INV	
21	Lau mamoe	Koster's Curse	*Clidemia hirta*	Herb	INT/INV	
22	Niu Vao	Palm (?)	*Clinostigma samoense*	Palm	NAT	
23	Kofe	Coffee	*Coffea arabica*	Tree	INT	
24	Kotia	Laurel (?)	*Cordia alliadora*	Tree	INT/INV	
25	Ti	?	*Cordyline fruticosa*	Herb	NAT (?)	
26	Anoso Vao/Lau Ninii/Lau lilii	?	*Cryptocarya elegans*	Tree	NAT	
27	Olioli	Tree Fern	*Cythea sp.*	Fern	NAT	
28	Laugasese	?	*Davallia soilida*	Fern	NAT	
29	?	Spotted Dumb Cane	*Dieffenbachia maculata*	Herb	INT/INV	
30	Anume	?	*Diospyros elliptica*	Tree	NAT	
31	Au'auli	Samoan Ebony	*Diospyros samoensis*	Tree	NAT	
32	Maota /Tufaso	?	*Dysoxylum samoensis*	Tree	NAT	
33	A'amati'e	?	*Elaeocarpus floridanus*	Tree	NAT	
34	Siapo Atua Sapatua /Siapatua	Blue-marble Tree	*Elaeocarpus grandis*	Tree	INT/INV	
35	?	?	*Erythrospermum acuminatissimum*	Tree	NAT	
36	Pua Lulu		*Fagraea berteroana*	Tree	NAT	
37	Mati		*Ficus godeffroyi*	Tree	NAT	
38	Aoa	Banyan	*Ficus obliqua*	Tree	NAT	
39	Filimoto	?	*Flacourtia rukam*	Tree	NAT	
40	Pulu Vao	African Rubber Tree	*Funtumia elastica*	Tree	INT/INV	
41	Fau	Beach Hibiscus	*Hibiscus tiliaceus*	Tree	NAT	
42	?	?	*Hedycaraya denticulata*	Tree	NAT	
43	Laufao	Heliconia	*Heliconia laufao*	Tree	NAT	
44	Vaepaa	Heliconia	*Heliconia sp.*	Tree	NAT	
45	Ifi	Polynesian Chestnut	*Inocarpus fagifer*	Tree	INT	
46	Filofiloa	?	*Ixora samoensis*	Tree	NAT	
47	Fu'afu'a	?	*Kleinhovia hospita*	Tree	NAT	
48	Latana	Lantana	*Lantana camara*	Shrub	INT/INV	
49	Papaono	?	*Litsea samoensis*	Tree	NAT	
50	Lau Pata	?	*Macaranga harveyana*	Tree	NAT	
51	Lau Fatu/Lau Pata	?	*Macaranga stipulosa*	Tree	NAT	
52	Mago	Mango	*Mangifera indica*	Tree	INT	
53	Fuesaina	Mile-a-minute	*Mikania micrantha*	Vine	INT/INV	
54	Nonu	Indian Mulberry	*Morinda citrifolia*	Tree	INT	
55	Tupe/Fuainu (?)	?	*Mucuna gigantea*	Vine	NAT	
56	Fai (taemanu)	Wild banana	*Musa. Sp*	Tree	NAT?	
57	Atone	Samoan Nutmeg	*Myristica inutilis*	Tree	NAT	
58	Atone/Atone ulu	?	*Myristica hypargyraea*	Tree	NAT	
59	Afa	?	*Neonauclea forsteri*	Tree	NAT	
60	Tootoo valea	Fire Spike	*Odontonema tubiforme*	Shrub	INT/INV	
61	Gasu	?	*Palaquim stehlinii*	Tree	NAT	
62	Vao Lima	Sour grass/T-grass	*Paspalum conjugatum*	Grass	INT/INV	
63	Ava'avaaitu		*Piper graeffei*	Vine	NAT	

64	Soga		*Pipturus argenteus*	Tree	NAT	
65	Ala'a	?	*Planchonella garberi*	Tree	NAT	
66	Mamalava	?	*Planchonella samoensis*	Tree	NAT	
67	Tava	?	*Pometia pinnata*	Tree	NAT	
68	Vi Vao	?	*Reynoldsia lanutoensis*	Tree	NAT	
69	Tavai	?	*Rhus taitensis*	Tree	NAT	
70	Faapasi/Tulipe	African Tulip-Tree	*Spathodea campanulata*	Tree	INT/INV	
71	Fana'io	?	*Sterculia fanaiho*	Tree	NAT	
72	Mahoki (?)	Mahogany	*Swietenia macrophylla*	Tree	INT	
73	Asi Vai	?	*Syzygium dealatum*	Tree	NAT	
74	Asitoa/Asi	?	*Syzygium inophylloides*	Tree	NAT	
75	Malili		*Termnalia richii*	Tree	NAT	
76	Koko	Cocoa	*Theobroma cacao*	Tree	INT	
77	Tuna (?)	?	*Toona sureni*	Tree	INT	
78	Avapui/Fana Povi (?)	Shampoo Ginger	*Zingiber zerumbet*	Herb	NAT	

ANNEX D: Photo Essay of Field Work throughout the Mt Vaea Trial Phase [Cyclone *Rene* Damage]

Plate 1: Large *Albizia* tree collateral damage

Plate 2: Large *Albizia* tree collateral damage

Plate 3: Damage across treatment trees

Plate 4: Access difficulty

Plate 5: Access difficulty

Plate 6: Opening canopy

Plate 7: Opening canopy

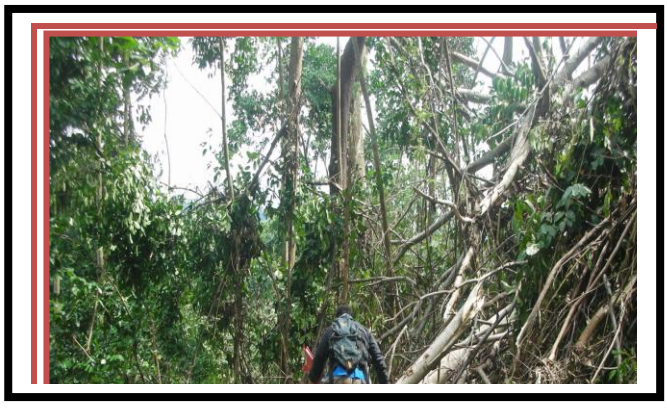

Plate 8: Opening canopy

ANNEX E: Photo Essay of Field Work throughout the Mt Vaea Trial Phase [Treatment & Replanting Trees]

Plate 9: Labelling treatment trees in field (Triclopyr=RED)

Plate 10: Field application of chemical

Plate 11: Field application of chemical

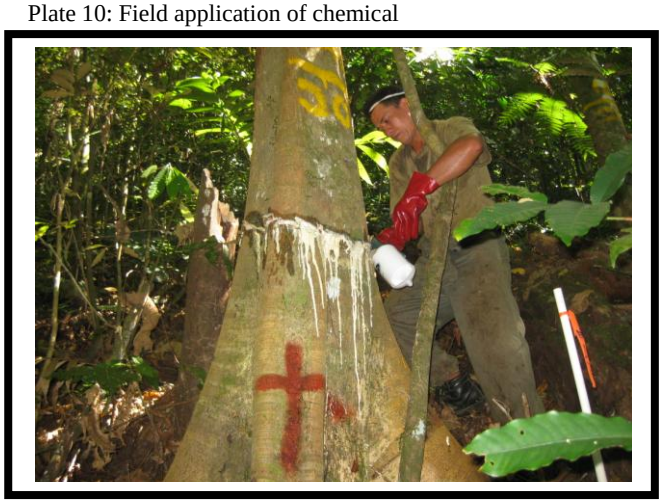

Plate 12: Hack squirt field application Pulu Mamoe rubber species

Plate 13: Basic "Fly Nursery" set up

Plate 14: Basic "Fly Nursery" set up

Plate 15: Basic "Fly Nursery" set up

Plate 16: Randomized field planting

ANNEX F: Photo Essay of Field Work Mt Vaea Trial Phase [Assessment of treatments = rankings]

Plate 17: No sign of effect [ranking code =0]

Plate 18: Slight sign of effect yellowing leaf [ranking code =1]

Plate 19: Strong sign no leaves bark ok [ranking code = 2]

Plate 20: Strong sign no leaves bark ok [ranking code = 2]

Plate 21: Strong sign no leaves bark alive [ranking code = 2]

Plate 22: Complete death rotten bark [ranking code = 3]

Plate 23: Complete death rotten bark [ranking code = 3]

Plate 24: Complete death rotten bark [ranking code = 3]

ANNEX G: Data Spread Sheets [Microsoft Excel] Provided of Relevant Field Work throughout the Mt Vaea Trial/Research Phase May 14- September 3, 2010

Please see attachments included