



*DFID Natural Resources Systems Programme*

**DFID Natural Resources Systems Programme, Land  
Water Interface Project R7668: Impact and  
amelioration of sediment and agrochemical pollution  
on Caribbean coastal waters**

**Report of a project visit to Jamaica and St Lucia by  
Nicole Esteban,  
22 November – 2 December 2001**

**MRAG**

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This activity of the project *Impact and amelioration of sediment and agro-chemical pollution in Caribbean Coastal Waters* was funded by the United Kingdom Department for International Development (NRSP LWI R7668). The conclusions and recommendations given in this report are those considered appropriate at the time of preparation. They may be modified in the light of further knowledge gained at subsequent stages of the Project. The findings of this report do not necessarily reflect the opinions or policies of DFID, MRAG Ltd or any other institution with which it may be associated.

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## EXECUTIVE SUMMARY

- This report documents the third field related activity for agro-chemical elements of the NRSP LWI project R7668 *Impact and amelioration of sediment and agro-chemical pollution on Caribbean coastal waters*. It will be distributed to all contacts made during this and previous project trips.
- The MRAG project researcher visited Jamaica and St Lucia during the month of November 2001. Nicole Esteban met with collaborating partners in both Jamaica (UWI, CARDI, C-CAM) and St Lucia (CEHI) and project activities were organised in association with collaborating partners.
- The objectives of the visit included the coordination of sampling activities at the three watersheds in St Lucia, gathering further material relating to critical control points for management and best management practices, and coordination of activities with collaborating partners.
- The majority of the trip has been documented through the use of reports for meetings held with collaborating partners and other institutions. Other activities have been recorded in tabulated format, and all reports/records are included in the body of this report.
- Highlights of the trip are described in the first section of this report, and include the completion of environmental sampling in St Lucia and a productive round-table meeting with all collaborators in Jamaica.
- A farmer survey by agricultural extension officers is currently underway in Jamaica (Wag Water and Rio Cobre watersheds) and St Lucia (Roseau, Praslin/Mamiku and Soufriere watersheds). The next project trip will take place in June 2002.
- All outputs for this project (including the first and second Trip Reports, Workshop Proceedings and the current Trip Report) are accessible on MRAG's web site ([www.mragltd.com](http://www.mragltd.com) – click on *Land Water Interface* and then *Selected project examples* – pdf'ed files are under R7668). Linkage has also been established between the project site and the Caribbean pesticides network.

## ACRONYMS

CARDI	Caribbean Agricultural Research and Development Institute
CBO	Community-based organisation
C-CAM	Caribbean Coastal Area Management Foundation (Jamaica)
CCST	Caribbean Council for Science and Technology
CEHI	Caribbean Environmental Health Institute
CGPC	Co-ordinating Group for Pesticide Control Boards of the Caribbean
CMS	Centre for Marine Science (UWI Mona Campus, Kingston)
CWIP	Coastal Water Improvement Project (Jamaica)
DFID	Department for International Development
DoC	Department of Chemistry (UWI Mona Campus, Kingston)
DoEH	Department of Environmental Health (St Lucia)
DoLS	Department of Life Sciences (UWI Mona Campus, Kingston)
ECLAC	Economic Commission for Latin America and the Caribbean
EJASP	East Jamaica Agricultural Support Project
ENACT	Environmental Action Programme (Jamaica)
ENCORE	Environmental and Coastal Resource Project (St Lucia)
EU	European Union
FAO	Food and Agricultural Organisation (of UN)
H&S	Health and Safety
IICA	Inter-American Institute for Cooperation on Agriculture
IMDG	International Maritime Dangerous Goods
LBA	Land-Based Activities
LWI	Land Water Interface
MAFFE	Ministry of Agriculture, Forestry and Fisheries (St Lucia)
MRAG	Marine Resources Assessment Group
MS	Member State
NEPA	National Environment and Planning Agency (Jamaica)
NGO	Non-governmental organisation
NPA	National Programme of Action
NPI	Natural Products Institute (UWI Mona Campus, Kingston)
NRCA	Natural Resources Conservation Authority
NRMU	Natural Resources Management Unit
NRSP	Natural Resources Systems Programme
OECS	Organisation of Eastern Caribbean States
PCA	Pesticides Control Authority (Jamaica)
PCB	Pesticides Control Board
PI	Principal Investigator
RADA	Rural Agricultural Development Authority (Jamaica)
SLASPA	St Lucia Air and Sea Ports Authority
SLBC	St Lucia Banana Corporation
SLBGA	St Lucia Banana Growers Association
SLSWMA	St Lucian Solid Waste Management Authority
SMMA	Soufriere Marine Management Association (St Lucia)
TQFC	Tropical Quality Fruit Company
UNEP	United Nations Environmental Programme
UoY	University of York
UWI	University of the West Indies
WASCO	Water and Sewage Commission, St Lucia
WIBDECO	Successor to WINBAN: Windward Islands Banana Development and
WINCROP	Windward Islands Crop Insurance (1988) Ltd
WRA	Water Resources Authority (WRA)

## 1 INTRODUCTION

This three-year research project *Impact and amelioration of sedimentation and agro-chemicals in Caribbean coastal waters* is funded by DFID's NRSP LWI programme (R7668). It follows on from an earlier LWI project *Review of the impacts of pollution by sediments and agro-chemicals of tropical coastal waters with reference to the Caribbean region* (R7111). The present project is managed and conducted by two organisations: the University of York, responsible for the sedimentation aspects of the project (activities commenced in June 2000 and are concentrated in the SMMA in St Lucia); and MRAG Ltd, responsible for agro-chemical components of the project (activities are undertaken in St Lucia and Jamaica). The project commenced in June 2000 and ends in July 2003. This trip report is the fifth output for the agro-chemical component of the project.

### 1.1 Purpose of visit

This visit to Jamaica and St Lucia took place in November-December 2001. In accordance with the activities set out in the project log frame, the purpose of the visit was:

- Coordination of sampling activities at the three watersheds in St Lucia and distribution for analysis;
- Follow up to information from structured interview analyses, and discussions with extension officers;
- Gather further material relating to critical control points for management and best management practices;
- Coordination of activities with collaborating partners.

### 1.2 Itinerary and meetings

The itinerary was set up around the schedule for sampling with CEHI in St Lucia. The final version of the itinerary is attached (Annexe 1: Itinerary). Meeting reports (including actions and follow-up) have been prepared for meetings with each institution and are presented in Section 2. The contact details of all relevant people and their institutions are given in Annexe 2 – Contact details.

### 1.3 Highlights of the Trip

- Completion of proposed environmental monitoring programme with CEHI in three watersheds (Roseau, Soufriere, Praslin/Mamiku) in St Lucia. The environmental monitoring programme is described in Section 3. Samples are presently being analysed by CEHI (sub-set of two out of three sub-samples) in St Lucia and the Central Science Laboratory (sub-set of one out of three sub-samples) in the UK. Analytical results should be available in February 2002.
- The farmer questionnaire survey was completed in St Lucia and still underway in Jamaica. Meetings took place to follow up on surveys, in particular to discuss statistical analysis by CARDI of data collected in survey.
- A useful and productive round-table meeting was held at UWI in Jamaica with representatives from all Jamaican collaborating partners (CMS, DoLS, DoC, CARDI, C-CAM). The meeting was briefed about status of independent project outputs by respective partners and commitments were made for final drafts. The

meeting discussed future project activities at length (analysis of farmer questionnaire, BMP, critical control points, relevant studies).

- A meeting was held with the Assistant Director of RADA to discuss their guidelines and recommended usage of agro-chemicals through their extension services.

#### **1.4 Future trips**

The next project trip is scheduled for June 2002. At present, planned activities for this trip include:

- Participation at 7<sup>th</sup> meeting of CGPC in Antigua;
- Presentation of review of two regional administrative pesticide databases and report on User Requirements (UR) analysis;
- Presentation of project activities to date, including environmental monitoring in St Lucia; and
- Coordination of activities with collaborating partners.

#### **1.5 Collaborative Arrangements**

Meetings were held with collaborating partners in St Lucia (MAFF: Departments of Agriculture and Fisheries; CEHI) and in Jamaica (UWI: CMS, DoC, DoLS; CARDI; C-CAM). The purpose of meetings was to discuss individual inputs to the project and to plan joint project activities. Collaborative arrangements have been set out in separate MoU's for each collaborating partner. Within each MOU although certain outputs are the responsibility of one collaborator, it is intended that all partners will be able to contribute and/or review all project outputs. All project reports have been circulated to collaborating partners with a review questionnaire for feedback of comments. In this way, the project will draw on the local, national and regional experience of all collaborating partners.

## 2 OUTCOMES

It was decided that the majority of this project trip would be most easily presented through the use of meeting reports. In this way, it is possible to document key discussions and conclusions of each meeting, and maintain a record of information useful for project outputs. This section includes the following:

- Reports from meetings held with collaborators and key informants in Jamaica;
- Environmental sampling programme in Roseau, Soufriere and Mamiku watersheds.
- Updated flow chart of critical control points for dissemination of project research outputs.

### 2.1 Reports from meetings held with collaborators and key informants in Jamaica

Meeting reports included in this section are set out as follows:

1. UWI/CMS meeting
2. Project round-table meeting
3. CCAM meeting
4. WRA meeting
5. PCA meeting
6. RADA meeting
7. DoC meeting

**Table 2.1 UWI/CMS meeting**

<b>Meeting between</b>	CMS (George Warner) MRAG (Nicole Esteban)
<b>Venue</b>	CMS, UWI Mona
<b>Dates of Meeting</b>	0900hrs-1000hrs Thursday 22 November 2001
<b>Points of discussion</b>	Review and feedback on the literature review as set out in MoU:  ‘Contribute with other project partners to a review of existing studies conducted in Jamaica relating to monitoring of agro-chemicals in the environment, with particular emphasis on the land-water interface and impacts in the marine environment, e.g. fate of chemicals, bio-accumulation rates, breakdown rates and transportation rates in the environment.  Unfortunately the author, Peter Edwards, was off island and so combined comments were fed back to GW for communication to PE.
<b>Discussion and commitments made</b>	

<b>Format and presentation</b>	<p>It was agreed that the 2<sup>nd</sup> draft document had improved considerably on the 1<sup>st</sup> draft and that the document was well presented and structured. PE was commended on the report. NE had annotated the report to show some typo errors and missing references and handed copy to GW.</p> <p><i>PE to revise document with regard to comments received from other reviewers and MRAG's annotated comments.</i></p>
<b>Broadening focus of report to St Lucia and wider Caribbean</b>	<p>GW/NE discussed the benefits of widening the focus of the report to include St Lucia and the wider Caribbean in general. This will enable the review to discuss a greater number of pesticides and their impact on the LWI. It will also enable comparison of results obtained in Jamaica, as some of these results are contradictory.</p> <p>Extension of this report was further discussed at the round-table meeting (see separate meeting report)</p>

**Table 2.2 Project round-table meeting**

<b>Meeting between</b>	CMS (George Warner) DoLS (Dale Webber) CARDI (Damion Nesbitt) CCAM (Brandon Hay) Nature Conservancy (Kimberley John) MRAG (Nicole Esteban)
<b>Venue</b>	Botany Seminar Room, UWI Mona
<b>Dates of Meeting</b>	1000hrs – 1300hrs Thursday 22 November 2001
<b>Points of discussion</b>	See attached agenda
<b>Discussion and commitments made</b>	
Introduction and review of agenda items	The meeting opened with a general introduction and welcome to newcomers. Damion Nesbitt was replacing Leslie Simpson due to other commitments and Kimberley John was attending due to possible project overlap and interest in freshwater ecotoxicology. NE opened discussion of project activities following the last round table meeting on 12 June, in particular a report on the CGPC meeting.
Review of Minutes of Last Meeting	MoLM on 12 June were reviewed and outstanding points were noted for discussion during this meeting.

DFID quarterly report (Quarter 2 – July-Sept 2001)	<p>NE opened discussion about activities included in the last quarterly report which had been distributed to all parties at the time of completion. NE reported on activities in St Lucia and Dominica (6<sup>th</sup> meeting of CGPC). The next quarterly report is due on 15 December 2001.</p> <p><i>All partners are requested to submit any comments for the quarterly report prior to this date.</i></p>
DFID mid term review (MTR)	<p>NE described the purpose and general ToR for the project MTR which is to be held in London on 11 December and in Jamaica during the week of 10-14 December 2001. The Caribbean review is to be conducted by Mr Everton Ambrose of IICA, St Lucia. EA has been given contact details for all project collaborators and is likely to contact them for individual meetings rather than a presentation. NE reported that EA is informed of project activities through his position as Secretary of the CGPC. NE also reported that she has a meeting with EA on 30 November as part of the review process.</p>
Status of reports and next stage	<p>NE reported that the second draft of all reports discussed during the last meeting had been received and had been circulated to other project partners for their review and comment. Completed review forms have been received from several partners and comments will be communicated to authors during individual meetings. NE pointed out that St Lucia partners will feedback comments during meetings in the week of 26 November and that she would then email comments. It is expected that the next draft of the report will be the final draft, and reports will be circulated to partners by NE for further review. NE asked partners to propose realistic deadlines for the final draft.</p> <p>Each partner reported separately:</p> <p><b>CARDI</b> – A progress report was handed to NE by DN as Leslie Simpson was unable to make the meeting. DN explained that he had been contracted to support project activities. The farmer questionnaires and farm addresses are now with RADA (89 for St Catherine, 35 for St Mary and 26 for St Andrews) and that they will request finalisation by 20 December. The deadline on the MoU for the final report is end Feb 02.</p> <p><i>As per progress report, LS will submit report sections as follows:</i></p> <p><i>Literature review: 30 Nov 02</i></p> <p><i>Appraisal of legislation/policies: 15 Dec 02</i></p> <p><i>Arrangements were made for a separate meeting with DN to discuss the project. However, this meeting was not possible and NE will get in touch with LS directly with feedback for the characterisation review.</i></p>

<p>Status of reports and next stage (cont.)</p>	<p><b>CCAM</b> – BH reported that the second draft had been submitted but that the fertiliser section was incomplete due to difficulties of extracting information. Information has also been collected on distribution chains, but is not yet included in the report.</p> <p><i>BH will submit final report with completed fertiliser section by end December 2002.</i></p> <p><b>CMS/DoLS</b> – The author of the Literature Review (Peter Edwards) was off island and this report was discussed by DW and GW. It was agreed that this report had been tightened up considerably following comments received on the 1<sup>st</sup> draft. Comparison of studies discussed in the report show contradictory findings and this fact will be followed up in the final draft. It was pointed out that this may be due to inconsistency or poor laboratory practices. It was suggested that a widening of the report would provide more comparative data (however a lot of studies are in Spanish).</p>
<p>Status of reports and next stage (cont.)</p>	<p>At present, Jamaican studies form a stand-alone document, and a new section will be produced for St Lucia and wider, relevant Caribbean studies, with annexes comprising other comparative data wherever considered appropriate.</p> <p><i>DW/GW agreed that the focus of the report will be widened to include literature from St Lucia and also studies/data from the wider Caribbean where considered important as means of comparison.</i></p> <p><i>DW pointed out that laboratory studies from temperate climates were also relevant if tropical conditions were simulated in the lab, and data would then be included.</i></p> <p><i>Final draft report to be submitted by end February 2002.</i></p> <p>DoC – representatives were unable to attend the meeting and the report will be discussed during a subsequent meeting with DoC (see separate report).</p>
<p><b>Use of agrochemicals and management:</b> Discuss analytical approach/define the sort of answers required from the questionnaire</p>	<p>The question of ownership and authorship was raised with regard to questionnaire data, and in the wider context.</p> <ul style="list-style-type: none"> <li>• Ownership: NE stated that the research was funded by DFID and findings were therefore available for subsequent research. However, any publication using project findings must bear the standard acknowledgement to DFID and the project (as stated at the beginning of project trip reports and workshop proceedings).</li> <li>• Authorship: NE pointed out that the MoU states that 'collaborative reviews will form the basis of joint authorship of scientific papers...'. <i>The meeting agreed that joint authorship should be proposed by anyone using research results, and that it was up to individuals to decide whether they wished for joint authorship.</i></li> </ul>

<p><b>Use of agrochemicals and management:</b> Discuss analytical approach/define the sort of answers required from the questionnaire (cont.)</p>	<p>Storage of data collected through questionnaires is extremely important so that data can be made available for future research, and can be handled by individual partners wishing to explore certain areas. <i>It was pointed out to CARDI that all partners wish for questionnaire data to be stored using Access.</i></p> <p>LS had previously informed MRAG that the questionnaires will be analysed by CARDI Trinidad. Project partners are unaware of the questions that are asked during analysis of a standard survey such as this and DN was unable to inform the meeting. As such, it is felt important to convey some of the points that the project would like to be analysed and this was discussed. A number of questions for analysis were discussed, and CARDI is requested to consider them (amongst others already planned):</p> <ol style="list-style-type: none"> <li>1. How does agro-chemical use (split into pesticide and fertiliser) in small farms compare to large farms?</li> <li>2. How does agro-chemical use (split into pesticide and fertiliser) in monoculture compare to mixed culture farms?</li> <li>3. Compare soil conservation in small farms versus large farms?</li> <li>4. Compare what farmers know versus what they do; what are the sources of difference (e.g. they know that they should use a certain pesticide but can't afford it)</li> <li>5. Does application rate change if the individual (small) farmer is spraying compared to an operator in a large farm?</li> <li>6. What is the source of information for small versus large farms?</li> <li>7. Is there a seasonal pattern of application (to compare to effect downstream)?</li> <li>8. Do soil types a) affect the processes of pollution downstream, and b) change application rates?</li> <li>9. What is the (perceived / actual) relationship between use and yield (split into small and large farms)?</li> <li>10. Is labelling a source of information for small or large farmers?</li> <li>11. Is there an effect of destination of crop (e.g. home or export use) on agro-chemical usage?</li> <li>12. How does knowledge vary between and amongst small and large farmers (a) for application rates, b) timing of application, and c) action/route of pesticide)?</li> <li>13. Does perception (qu 50) differ from practice and give the reason(s)?</li> <li>14. Has the PCA campaign affected use/perceptions? <i>(NE to feedback information on campaign from her meeting with PCA).</i></li> </ol> <p><i>LS to review questions and feed into analytical procedures. It was suggested that, to save time, the questionnaires should be sent to CARDI Trinidad now in order to set up the database and plan approach. NE to verify that St Lucian questionnaires have been sent to LS.</i></p>
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<p><b>Critical control points for management</b></p>	<p><b>All partners were to consider any additional institutions that should be contacted and feedback to this meeting</b></p> <ul style="list-style-type: none"> <li>• The Pollution Control Unit at NEPA have an active sampling and monitoring programme and are contacting NGO's at present in order to collect all information available and set it up on a national database.</li> <li>• The WRA at Ministry of Water and Housing have a long term monitoring programme (1960s onwards) of wells and surface waters, and also do spot measurements (of salinity, pH, DO).</li> <li>• CWIP at NEPA also have a programme studying nutrient levels.</li> <li>• R2R may have a monitoring programme planned for their study watersheds.</li> <li>• Dr Hessup has a project monitoring endosulfan in the Rio Cobre and impact on gastropods.</li> </ul> <p><i>NE to contact USAID who previously proposed to support our project in any related activities.</i>  <i>KJ to follow up with Dr Hessup and feedback to partners.</i></p> <p><b>Review attached framework for critical control points</b>  Critical control points (CCP's) had been summarised in a framework (see <b>Error! Reference source not found.</b>) which was presented to the meeting. Several additional CCP's were pointed out such as NEPA's Pollution Control Unit (nutrient loading/turbidity? around the island), the WRA and Nature Conservancy (with JCDT, NEPA, WRA).</p> <p><i>Time was running short and NE asked partners to consider the framework and feedback any additional CCP's.</i></p>
<p><b>Options for future monitoring</b></p>	<p><b>2.2 Monitoring of imports</b>  With exception of CCAM, none of the partners have experience of import monitoring and this was discussed in separate meeting with CCAM (see meeting report).</p> <p><b>Environmental monitoring (based on costs)</b>  The meeting discussed alternative systems for monitoring, including project monitoring (e.g. a range of parameters, including pesticides), ecosystem monitoring (population dynamics), environmental monitoring (with particular source material). The majority of past studies have focussed on particular pesticides (often those that are easy to analyse) in one location and there has not been an island wide system for monitoring.</p> <p>It was agreed that a number of factors should be considered in designing a monitoring programme:</p> <ul style="list-style-type: none"> <li>• Watershed characteristics</li> <li>• Sampling station specifics</li> <li>• Chemical selection</li> <li>• Seasonality</li> <li>• Biota (e.g. birds)</li> </ul>

<p><b>Options for future monitoring (cont.)</b></p>	<p>The value (and cost) of the above would act as tools for a monitoring programme.</p> <p>Various monitoring programmes/projects are currently underway, and include:</p> <ul style="list-style-type: none"> <li>• CARICOMP programme: coral reef focussed monitoring managed by CMS. Results have not shown any particular degradation locations due to land based pollutants.</li> <li>• CWIP WQ monitoring programme: not covering WagWater or Rio Cobre (limited to Negril, Ocho Rios and Discovery Bay). However, they are setting up a national WQ monitoring programme for NEPA, to include rivers and coastal water. They are presently identifying what should be done, including parameters, sites, agencies and are including community groups.</li> <li>• Nature Conservancy: several tailored monitoring programmes for organic pollution (e.g. sugar, bauxite, sand mining)</li> <li>• The Jamaican Conservation Development Trust (JCDT) are sampling headwater streams at Wagwater and monitoring basic water parameters and biological species as part of the John Crow Mtn project.</li> <li>• WRA have ground- and surface water monitoring (see separate meeting report).</li> </ul> <p><i>GW to communicate CARICOMP conclusions/results (as above) to NE.</i></p> <p><i>KJ to communicate their monitoring programmes to NE.</i></p> <p><i>KJ to send information to NE on WagWater project and on development of biological indicator programme.</i></p>
<p><b>AOB</b></p>	<p>NE thanked all project partners for attending the meeting and contributing to the discussions. Timing of the next project visit was uncertain and to be communicated to partners ASAP. The meeting closed at 1300hrs.</p>

**Table 2.3 CCAM meeting**

<b>Meeting between</b>	CCAM (Brandon Hay) MRAG (Nicole Esteban)
<b>Venue</b>	UWI Mona
<b>Dates of Meeting</b>	1300hrs-1430hrs Thursday 22 November 2001
<b>Points of discussion</b>	Review and feedback on CCAM's report on administration systems for agro-chemical management
<b>Discussion and commitments made</b>	
Format and presentation	<p>NE/BH discussed the combined comments and feedback from other project partners. It was agreed that NE went through the report that had been annotated with comments from MRAG.</p> <p><i>BH to incorporate all comments into the final draft by end December 2001.</i></p> <p>CCAM have held a large number of consultative meetings in order to prepare this document, and it is felt that this should be reflected with a table of people contacted.</p> <p><i>BH to annexe a table of people/institutions consulted.</i></p>
<b>Fertilisers – import and distribution systems</b>	<p>Fertilisers were not included in the 1<sup>st</sup> draft document and had been added as an additional section in the 2<sup>nd</sup>. It was understood that this section was unfinished as BH had been unable to understand the complete system with regard to import of fertilisers. Consequently, no recommendations for fertilisers have been presented in the 2<sup>nd</sup> draft. It is possible that there are no management systems for fertiliser import and, if this is the case, this should be stated. CCAM has also collected information about distribution of fertilisers, and this will be included in the final draft.</p> <p>CCAM has been unable to draw up an administration systems chart for fertiliser import and manufacture (similar to pesticide import and manufacture) due to lack of software. <i>It was agreed that CCAM would design the appropriate chart and fax/email copy to MRAG for final design using Visio programme.</i></p> <p>The report needs additional information about any export of fertiliser.</p>

<b>Fertilisers – import and distribution systems (cont.)</b>	<p>It was agreed that recommendations for fertilisers will be described separately to those for pesticides.</p> <p>It was also pointed out that the import data for fertilisers was better placed within section 4.2, and that the source should be acknowledged, and information about fertiliser mixes (i.e. ratios of N:P:K etc) also included.</p> <p><i>BH to action all above points for inclusion in final draft. NE to question RADA and PCA about systems for fertilisers (see other meeting reports for info). NE to design administration charts (fertiliser import and fertiliser manufacture) upon receipt of information from CCAM.</i></p>
<b>Pesticides – import and distribution systems</b>	<p>It was agreed that information on import of pesticides was almost complete with the exception of the following:</p> <ul style="list-style-type: none"> <li>• No information is known about systems at Customs &amp; Excise with regard to import controls, records (database?), approach to banned substances and liaison with PCA.</li> <li>• The report does not include systems/quantification of export of pesticides. This is relevant to estimation of the total quantity utilised in Jamaica.</li> <li>• It had previously been agreed (meeting of 8 June) that CCAM would extend the pesticides import and manufacture charts with information collected about the distribution chain. BH reported that it was impossible to edit the chart with software available. NE agreed to edit charts using amendments to be sent by BH.</li> </ul> <p><i>BH to action the above points. NE to edit pesticide administration charts (import and manufacture) with information from CCAM.</i></p>
<b>Restricted and banned pesticides</b>	<p>These have not been listed in the report since CCAM has given the appropriate documents to MRAG.</p> <p><i>BH to check that he has sent the lists for banned and restricted pesticides. BH to post other relevant documents to MRAG. NE to incorporate lists into document as annexes.</i></p>
<b>PCA campaign</b>	<p>The ‘Mine yu cide’ campaign organised by PCA was discussed and it was felt important to include details of the campaign, and any results/outcomes in the report.</p> <p><i>NE to communicate any information collected in meeting with PCA.</i></p>

<b>Review of other project reports</b>	<p>CCAM has not yet responded with feedback/comments about other project reports. NE pointed out that their contribution would be useful, particularly with regard to their experience in Portland Bight, other literature available, and environmental monitoring. NE also requested that Peter Espeut review questionnaire and suggest questions for analysis (similar to activity in the round table meeting).</p> <p><i>CCAM to review reports and feedback forms by end Nov 01. PE to review questionnaire and feedback analytical queries ASAP.</i></p>
<b>Environmental monitoring</b>	<p>The monitoring programme at Portland Bight was discussed in relation to experience appropriate to this project. CCAM have introduced a community-based monitoring system of WQ and are using community inputs for sampling. Community inputs are vital when monitoring sporadic WQ problems, and had evolved after 2 previous experiences when NEPA were called in to inspect a fish kill but had not arrived in time (1<sup>st</sup> occasion) and had not fed back results of the visit (2<sup>nd</sup> occasion). Consequently, the programme is organised so that communities can sample sporadic WQ events and conduct beach monitoring through citizens' councils (set up in Portland Bight PA). Results from monitoring are presented at meetings.</p> <p>CCAM have a lab with flow injection equipment (not yet set up) and a multimeter.</p> <p><i>BH to consult with PE about alternative monitoring options and CCP's (as discussed at round table meeting) and feed back discussion to NE ASAP.</i></p>

**Table 2.4 WRA meeting**

<b>Meeting between</b>	WRA (MD, Basil Fernandez) MRAG (Nicole Esteban)
<b>Venue</b>	WRA, Hope Gardens
<b>Dates of Meeting</b>	1500hrs-1600hrs Thursday 22 November 2001
<b>Points of discussion</b>	Project activities WRA activities
<b>Discussion and commitments made</b>	

<b>Mandate of WRA</b>	<p>The WRA is the hydrological agency of the Ministry of Water and Housing and has a mandate to monitor water resources of Jamaica. Activities include:</p> <ul style="list-style-type: none"> <li>• Allocation of water resources (permits/licenses) including domestic, industrial and agricultural;</li> <li>• Monitoring of ground water levels and well drilling, pumping and abstraction;</li> <li>• Monitoring of surface water flows;</li> <li>• Monitoring of WQ of ground- and surface water; and</li> <li>• Assessment of hydrological basins in terms of availability and WQ.</li> </ul>
<b>Background information</b>	<p>The hydrological agency was formed in the 1960s when saltwater intrusion occurred as a result of overpumping. The agency monitored physical and chemical parameters (especially conductivity and salinity). The Water Resources Act of 1966 also gives control of groundwater pumping to prevent saline intrusion.</p> <p>During the 1980s, industrial contamination was primarily caused by bauxite and aluminum extraction. The WRA started to monitor WQ caused by mining and also by small investors, such as agro-industries (rum distillers, sugar factories). The WRA has played an increasing role in monitoring pollutants.</p>
<b>Project study watersheds</b>	<p>BF described WRA monitoring in Rio Cobre and Wagwater watersheds:</p> <p><b>Rio Cobre</b></p> <ul style="list-style-type: none"> <li>• Agro-industrial complex at Bogwalk in the upper Rio Cobre produces citrus juice, condensed/evaporated milk (Nestle), milk products (Milo) and Trujuice.</li> <li>• Coffee factory on Thomas River, tributary to the Rio Cobre.</li> </ul> <p>Copies of two relevant studies were delivered to NE:</p> <ul style="list-style-type: none"> <li>• Fernandez, B. and Wint, M. (1991) Contamination of the Rio Cobre by effluent from the agro-industrial complex at Bog Walk, St Catherine. WRA, Kingston: August 1991.</li> <li>• Hill, V.G. and Taylor, W.A. (1966) A study of the effects of industrial wastes on the oxygen values of the Rio Cobre. SRC Technical Report 1/66.</li> </ul> <p><b>WagWater</b></p> <p>Very little work has been done with respect to monitoring of WQ.</p>

<p><b>WRA monitoring programme</b></p>	<p>The WRA has no laboratory so all analysis is contracted out to the Environmental Health lab or a number of smaller labs. BF reported that 2 significant problems exist: no lab is sufficiently equipped to analyse the complete suite of parameters, and there is a problem of quality control [NB this is seen in the project's literature review].</p> <p>WRA long term monitoring data (1970 – present) do not indicate any significant changes in WQ on the island. There have been no changes in nitrates in general. The WRA environmental officer was out of office and BF gave her contact details to access any relevant monitoring information which is stored in the WRA database (Michelle Watts – &lt;mWatts&gt;wra@colis.com).</p> <p>WRA's monitoring programme is also severely hampered by lab costs and monitoring is often funded through projects, e.g., impacts from the rum distillery in Black River basin, and use of effluent for irrigation fields (BOD, SS, biomonitoring).</p> <p>A CIDA funded study of the use of fertilisers and pesticides in 3 agricultural areas of southern Jamaica was conducted by Paragon Consultancy (Rivers Minho, Cobre, Black) to look at impacts from sugar, banana and mixed crop. Water samples (60-70 samples from the 3 watersheds) were collected quarterly for analysis of nutrients for impact of fertiliser, water samples were collected every 6 months (wet and dry season) for analysis of pesticides. Reports from this study show that no water samples indicated pesticide residue. Elevated nitrates (estimated to be related to housing with sewage disposal via soakaways in areas of high groundwater levels) were found. Ammonia levels were low.</p> <p>The WRA also work with NEPA to decrease discharges, and license effluent discharges (through the Pollution Control Unit). Discharge regulations have been established and are implemented through NEPA. Unfortunately, these regulations are applicable to new industries, and existing industries have a considerable timeframe in which to adhere to regulations.</p>
<p><b>Current projects</b></p>	<p>The WRA and NEPA are presently setting up a national WQ and sediment loading (streams) monitoring programme.</p> <p>The WRA have produced an atlas on WQ in draft form which has collated information from all agencies (including pesticides, nutrients, chemicals, industrial pollution, saline intrusion).</p> <p>The WRA is currently monitoring WQ around one bauxite company in Clarendon (part of ongoing study including Na, pH, heavy metals, organic content, pesticides) and is sampling twice per year to be analysed by an EPA certified lab in Florida.</p> <p><i>BF will send table with results to NE</i></p>

**Table 2.5 PCA meeting**

<b>Meeting between</b>	PCA (Hyacinth Chin Sue) MRAG (Nicole Esteban)
<b>Venue</b>	PCA, King Street
<b>Dates of Meeting</b>	0830hrs-1000hrs Friday 23 November 2001
<b>Points of discussion</b>	Follow up on previous discussions Update on project activities Questions about PCA systems (based upon research)
<b>Discussion and commitments made</b>	
<b>Follow up on previous discussions</b>	<p>During recent email exchanges, HC-S had suggested that collaboration between MRAG and PCA be formalised since they should be a project partner. MRAG had responded by sending a draft MoU for review by the PCA. This was discussed and HC-S expressed interest in the project, but that it was not a priority in her work. The PCA remains interested in research findings. NE stated that collaboration was of importance to the project, and that the project team realises the relevance of PCA's participation in terms of experience, review of results, positive feedback and relevant dissemination. However, NE realised the quantity of work at the PCA and suggested that communication of research findings would still take place via the CGPC.</p> <p><i>HC-S will review draft MoU and confirm decision to MRAG.</i></p> <p>MRAG has previously requested the dataset for imports during 1997-8. HC-S agreed that there is no problem for MRAG to have these data, and has no problem with MRAG contacting the database manager at UWI directly.</p> <p><i>NE to contact Garvin Gordon to request data for 1997-8. NE to email data received to HC-S.</i></p>
<b>Update on project activities</b>	<p>NE reported that the 2<sup>nd</sup> draft of 4 reports had now been completed and were available to PCA. HC-S expressed interest in all final reports from the project.</p> <p><i>NE to send all final reports to PCA.</i></p> <p>NE updated on the project activities since the last meeting at the CGPC in Dominica (21 June 2001), in particular this field trip to sample for agro-chemicals. HC-S is interested in research results.</p> <p>NE described progress on the review of databases for the CGPC and requested that HC-S complete the UR analysis questionnaire recently sent to participating countries. HC-S responded that she didn't think it relevant since Geref is operational. NE stated that questionnaire results important, especially since PCA's database experience would perhaps provide an alternative response to other member states.</p> <p><i>HC-S to complete questionnaire and send to MRAG ASAP.</i></p>

<p><b>Questions about PCA systems (based upon research)</b></p>	<p><b>Reasons for banning/controlling a pesticide (LD50, WHO toxicity, environmental stability, e.g., Lannate (methamyl))</b></p> <ol style="list-style-type: none"> <li>1. The priority is to check the history of damages to health or the environment in other countries (e.g. pesticide showing up in breast milk), especially in Central or South America. The PCA also checks records of Poison Control Centres, as well as the Toxic Exposure Survey of the US (<a href="http://www.epa.gov">www.epa.gov</a>).</li> <li>2. The PCA verifies whether the pesticide is banned in other countries.</li> <li>3. The PCA checks that the pesticide is registered for use in the country of manufacture.</li> <li>4. The PCA does consider LD50, but this is not the first priority.</li> <li>5. With regard to WHO toxicity categories, it is possible that the same AI is registered under 2 or 3 classes because it has a different formulation. However, PCA considers that it is still the same AI and therefore WHO classification is not necessarily reflective of toxicity. If it is a Class I pesticide, then it will be banned. If it is class II or IV, then the PCA looks for other evidence.</li> </ol> <p>The example of Lannate (methamyl): it is a broad spectrum pesticide and can be applied to at least 50 different crops, however broad spectrum pesticides also kill useful pests. The poisoning centre cases report (from Internet) show that Lannate is extremely toxic, and it has been banned in the US in several formulations (US Toxicity class I). For this reason it is banned. HC-S feels that too much emphasis is placed on fate in the environment, and not on human health.</p> <p><b>Why did imports decrease between 1996 and 1998, and then increase by over 50% between 1998 and 1999?</b></p> <p>HC-S was not registrar during this period but put forward several suggestions:</p> <ol style="list-style-type: none"> <li>1. More chemicals were classified as pesticides in the PCA;</li> <li>2. Black ciagatoca disease was introduced on bananas in about 1998; and</li> <li>3. The El Nino brought heavy rains and then drought so that there were no crops to spray. The majority of pesticides are fungicides and so obviously less of a problem during drought.</li> </ol> <p><i>NE to check with former registrar Paul Whyllie. NE to compare agricultural production with imports.</i></p>
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<p><b>Questions about PCA systems (based upon research) (cont.)</b></p>	<p><b>Has the 2000 Annual Report been published?</b>  The 2000 Annual Report was published (NE received copy) but the reporting dates have shifted from annual year to financial year, therefore the 2000/01 Annual Report covers April 2000 to March 2001. HC-S pointed out that the 1999 Annual Report was published, but that figures were changed for government approval (to financial year), and the financial year report was not printed. Therefore, official figures quoted for this year may differ from those shown in the report.</p> <p><b>Update on programme for licensing operators</b>  The PCA have started programme for operators at households and hotels. Other categories (specific termite or fumigation and farms have not yet started). A series of 2day workshops have been organised. Training is not obligatory but a written exam (pass rate of 65%) is compulsory for the license, followed by a practical exam whereby inspectors observe the operator in their job. All employees now have to be licensed, however if a direct supervisor is licensed, then operators do not need to be. All information is stored on a separate database.</p> <p>The programme for certification of farm operators will start in early 2002. The PCA have moved slowly in order to work together with RADA in this respect. It is possible that training may be specific to crops, and that the PCA will work with chemical companies, who have their own field days/extension services. The question of raising funds for farm operator licenses was discussed.</p> <p>Legislation for licensing has been drafted but not yet passed. All operators are in a grace period, however have an incentive to gain the license since it improves job prospects. The programme is not self funding at present.</p> <p><b>In the 1999 Annual Report, the Minister instructed the PCA to review requirements for licenses to repackage a pesticide, what has happened since then?</b></p> <p>HC-S was not aware of this but then wasn't registrar at this time. The PCA have, however, been reviewing licenses, and have looked at farm stores which are re-packaging. It is planned that the PCA will issue the license to sell so therefore the store will need to meet requirements. A consultancy study in the New Economy project put forward recommendations.</p> <p>It is possible that the re-packagers will be treated as manufacturers, and that these standards will be revised. However, what type of label should be attached and this has legal/WTO implications. The PCA have started the process by listing all products that are repackaged, and are considering legislation.</p>
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<p><b>Questions about PCA systems (based upon research) (cont.)</b></p>	<p><b>A 2000 target was to plan a licensing programme for retailers of restricted pesticides, has this gone ahead?</b></p> <p>There are 3 restricted pesticides and details are set out below:  Methylbromide: restricted following signing of the Convention about ozone depletion. It can only be used for plant quarantine.  Endosulfan: this can only be used by coffee growers and is imported/managed by the Coffee Board. Only registered growers can buy it, and records are kept/signed.  Lannate: records have not been collected and PCA is following this up. Certain shops are authorised to sell.</p> <p>If farm stores selling restricted pesticides without taking due records, then the PCA sends written reports stating that they have not met the legal requirements. The store is then informed not to sell the pesticide. However, there is a problem with not having sufficient number of stores that have a license to sell, and thus making the pesticide unavailable.</p>
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**Table 2.6 RADA meeting**

<b>Meeting between</b>	RADA (Thomas Burton and, briefly, Phillip Chung) MRAG (Nicole Esteban)
<b>Venue</b>	RADA, Hope Gardens
<b>Dates of Meeting</b>	1300hrs-1415hrs Friday 23 November 2001
<b>Points of discussion</b>	<ul style="list-style-type: none"> <li>• Briefing and update on project activities</li> <li>• RADA operations</li> <li>• Soil conservation</li> <li>• Fertiliser import</li> <li>• Questions about RADA systems</li> <li>• RADA guidelines</li> <li>• Organic farming</li> <li>• Project dissemination workshop</li> </ul>
<b>Discussion and commitments made</b>	
<b>Briefing and update on project activities</b>	<p>NE briefed TB about project activities, in particular on soil and agro-chemical management, and discussed the input that RADA was giving with regard to the Project Workshop in June and the farmer questionnaire survey in WagWater and Rio Cobre watersheds. This questionnaire survey has just started and RADA have been requested by CARDI to complete by 20 Dec 01.</p> <p>NE described project reports that had been drafted and explained that they were available to RADA. TB and PC expressed interest in project reports.</p> <p><i>NE to send various trip/workshop reports to RADA.</i></p>

<p><b>RADA operations</b></p>	<p>RADA has 60 field officers responsible for 60 different geographical areas. The size of each geographical area varies according to number of farmers and type of crop (e.g. if lots of permanent crops like citrus then the extension area is made larger as commodity farmers have their own extension through their agricultural boards). Each officer is supposed to hold 2 training sessions per extension area per month.</p> <p>RADA tries to assist all farmers irrespective of crop type and size, including livestock farming (and offers training in castration and wound dressing). The social services/home economics department of RADA deals with the farm family and encourages them to use products that provide better nutrition, and to assist via their own projects. However, RADA focuses on domestic agricultural crops and prioritises small farmers as large farmers are generally commodity based and receive support from their farm board. Different training sessions include livestock, crops, farm management and record keeping.</p> <p>All field officers must have a College of Agricultural Science educational qualification so have a basic training on agro-chemicals and soil conservation.</p> <p>The RADA annual development plan describes the strategy for different training sessions. Each parish prepares a development plan which fits into the national plan with activities streamlined in order to achieve it. Two zonal directors are responsible for RADA planning (west: Mr Trevor Martin at Montego Bay and east: Miss Edie Gidden in Kingston – kingstonja@cwjamaica.com).</p>
<p><b>Soil conservation</b></p>	<p>Within RADA, a separate section on land husbandry (i.e. soil conservation) has 7 parish officers who are placed in parishes to train other extension officers. RADA no longer has funding to practice mechanical protection (they used to own and hire out equipment to farmers but it wasn't cost effective and RADA couldn't maintain the equipment).</p> <p>RADA now encourage farmers to use what they have on the land. Land husbandry techniques promoted by RADA include:</p> <ul style="list-style-type: none"> <li>• Stone barriers</li> <li>• Grass cover crop (harvested and then used as fodder for livestock)</li> <li>• Trees (<i>Lucina</i>, <i>Caliendra</i>) that grow fast and form barriers</li> <li>• Contour planting</li> </ul>

<p><b>Soil conservation (cont.)</b></p>	<p>The role of extension is to teach land preparation and soil planting methods. Sometimes the farmer does something that is difficult to reverse, sometimes geographical location makes it impossible to work (e.g. too hilly). There is no standard manual for land husbandry, and RADA gives in-service training to field officers in order to keep their techniques current.</p> <p>Farmers are encouraged to determine the soil type on the farm and RADA officers bring soil to the lab at the Rural Physical Planning Unit. The lab makes recommendations and field officers are also trained to interpret results and make recommendations to farmers. Many farmers don't know their soil type due to cost of analysis, and farmers then use traditional recommendations. The fertiliser company, Antilles Chemical Company (ACC) Ltd (the only manufacturers of dry blend and 95% of all fertiliser brought from them; 5% is imported by the sugar cane board) issues basic guidelines for application of fertiliser using soil type based on historical analyses.</p>
<p><b>Fertiliser import</b></p>	<p>The Jamaican market is open and there are no import restrictions. ACC imports their ingredients and manufactures in Jamaica. There is no advantage to import readily made fertiliser as it is more expensive. However, the sugar cane industry have recently started importing as they say they have found a cheaper source (but the product they imported was apparently dumped on the market so it is not true market price).</p>
<p><b>Questions about RADA systems</b></p>	<p><b>Guidelines issued for agro-chemical management:</b> RADA have moved away from the 'pesticides only' approach and are currently encouraging farmers to use IPM and are conducting training sessions in all parishes for all farmers. Part of these sessions focuses on IPM in accordance with export requirements since IPM is increasing in importance for export crops, especially to the USA (through USEPA). Farmers are requested to use pesticides with shorter residue effects.</p> <p><b>Coordination with PCA:</b> All pesticides to be used (and therefore recommended by RADA) are cleared by the PCA. A Senior Plant Protection Officer from RADA is on the PCA Committee and therefore coordinates requests to use new/modified pesticides, either when a new product comes on the market, or when a new disease requires treatment. The Senior Plant Protection Officer communicates information to field officers via two zonal officers.</p> <p><b>Communication with farm stores/manufacturers:</b> RADA has regular contact with farm stores selling pesticides and fertilisers. When a new product arrives on the market, RADA provides training days for farmers (often sponsored by the store). Chemical companies notify RADA of their training days so that they can coordinate training.</p>

<p><b>RADA guidelines</b></p>	<p>RADA head office maintains a list of recommended pesticides for certain diseases/crops. This list is given to field officers to implement recommendations. Besides these guidelines, RADA has a number of published guidelines (NE received copy) for extension officers and farmers:</p> <ul style="list-style-type: none"> <li>• Best Bet Technology : pineapple barriers</li> <li>• Best Bet Technology: minimum tillage</li> <li>• Technology and generation validation: How to make and use the A frame</li> <li>• Warning: Jamaican hot pepper exports must be fumigated</li> <li>• How to grow cauliflower: a training manual for farmers</li> <li>• Hot pepper production: a training manual for farmers</li> <li>• How to grow broccoli: a training manual for farmers</li> <li>• Fertiliser usage: a training manual for farmers</li> <li>• Getting the best from farm pesticides</li> <li>• Crop profile: callaloo</li> <li>• Crop profile: cabbage</li> <li>• Crop profile: cucumber</li> <li>• Notes on integrated management of callaloo</li> <li>• Notes on integrated management of sweet potato</li> <li>• Pests of pawpaw and their management</li> </ul> <p>RADA is presently working to put together a complete set of guidelines.</p>
<p><b>Organic farming</b></p>	<p>RADA is trying to introduce farmers to organic farming and the Organic Growers Association (OGA) has been established, although still in early phases. OGA has been housed in Ministry of Agriculture buildings in order to encourage the organic movement. Dr Lindsey from Research and Development Division of RADA is the Chairperson of the OGA. It is currently gaining momentum prompted by a general call for healthier produce and also the rastafarian movement (one of the larger organic farms in St Thomas is operated by rastafarians).</p> <p>The OGA has 2/3 inspectors to certify organic growers. It is planned that a training seminar in organic production in Dec 01 will increase the number of certified inspectors, and RADA field officers have been encouraged to participate.</p> <p>Organic production has increased in coffee and some vegetables. A large number of small farmers are interested in certifying their farms as organic (ironically, their farming is organic due to lack of funds for agro-chemicals), however the small size of parcels (and the size of the 'no use' barrier required around organic fields) limits possibility for organic farming on small farms. Another limiting factor is the production of organic fertiliser (composting) and one company did produce organic fertiliser, but has recently stopped. RADA is encouraging composting through training sessions (how to construct and locate bin, handle and use compost, etc).</p>

<b>Project dissemination workshop</b>	The end of project dissemination workshop is planned to focus on discussion of draft guidelines for best management practices. This aim was discussed and TB expressed interest that RADA would attend. He also suggested that the Coffee and Banana Boards be invited as they are often accused of being major polluters.
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**Table 2.7 UWI/DoC meeting**

<b>Meeting between</b>	DoC (Tara Dasgupta, Malvern Spencer, Craig Perue) DoLS (Dale Webber) MRAG (Nicole Esteban)
<b>Venue</b>	DoC, UWI Mona
<b>Dates of Meeting</b>	1430hrs-1615hrs Friday 23 November 2001
<b>Points of discussion</b>	<ul style="list-style-type: none"> <li>Briefing and update on project round table meeting (as DoC was unable to attend)</li> <li>Discussion of 2<sup>nd</sup> draft of toxicity report</li> </ul>
<b>Discussion and commitments made</b>	
<b>Briefing and update on project round table</b>	The topics under discussion at the round table meeting were briefly summarised to TG, MS and CP.  <i>NE to send meeting report of round table to DoC.</i>
<b>Discussion of 2<sup>nd</sup> draft of toxicity report</b>	<p>NE explained that several factors were missing from the report, in particular:</p> <ul style="list-style-type: none"> <li>There is no mention of fertilisers and toxicity of nutrients</li> <li>A toxicity table had been produced for St Lucia in June but had not been included in the report. The report only refers to Jamaica and needs to be extended to St Lucia.</li> <li>ToR for the report state that recommended management procedures for agro-chemicals should be described; this has not been done. It is expected that recommendations arising out from the report be a separate section (currently the final section)</li> <li>There is no mention of breakdown rates, and it is important to state that no knowledge exists if this is the case.</li> <li>Toxicity has not been defined</li> </ul> <p>It was concluded that the report requires restructuring. The present main section on different pesticide groups will be extended to include St Lucia, and other Caribbean countries where appropriate. A new structure was discussed and agreed, as follows:</p>

<p><b>Discussion of 2<sup>nd</sup> draft of toxicity report (cont.)</b></p>	<ol style="list-style-type: none"> <li>1. Introduction</li> <li>2. Toxicity (description of major agro-chemicals AND table)             <ol style="list-style-type: none"> <li>(i) pesticides in Jamaica and St Lucia (and elsewhere)</li> <li>(ii) fertilisers</li> </ol> </li> <li>3. Recommended management procedures             <ol style="list-style-type: none"> <li>(i) as many pesticides as possible in section 2</li> <li>(ii) fertilisers</li> </ol> </li> <li>4. DoC recommendations based on sections 1-3, their own experience and on alternative monitoring options (both administrative and environmental)</li> </ol> <p>The combined comments received from reviewers were presented to the DoC team and were extensively discussed. DoC will act on all comments received in the final draft of the report (e.g. reference to information sources, comment on partition coefficient, explanation of prioritisation and reason for inclusion of particular characteristics in toxicity table, background to recommendations such as analysis of the entire fish).</p> <p>NE requested that the report be produced using the standard template given to all project partners. DoC were also requested to refer to the import data that was sent to them for Jamaica and St Lucia (with regard to prioritisation for monitoring, looking at the reason for decrease and then rapid increase in imports, etc).</p> <p><i>NE to resend import data for St Lucia and Jamaica DoC final draft report to be submitted to MRAG by end Jan 02.</i></p>
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## 2.3 Environmental monitoring programme

### 2.3.1 Background

Sampling site locations were discussed with a number of institutions during the first project trip and it was concluded at the time that sampling should take place at four different stations in three watersheds: Roseau, Praslin/Mamiku and Soufriere (see First Trip Report). Suitable monitoring stations were subsequently identified during the second project trip and the environmental monitoring programme was then submitted to DoF for approval (granted by Dawn Pierre of DoF on 12/10/2001). The principal objective of this trip was to complete all sampling as proposed in St Lucia, and to transport the sub-sample back to the UK (CSL laboratory).

Lists of registered pesticides imported to St Lucia were provided to the project team by the Secretary of the PCB, Mr Guy Mathurin (Table 2.8). The data were analysed for priority pesticides by MRAG Ltd using a toxicity review prepared for the project by the Department of Chemistry at the University of the West Indies (UWI), Mona Campus in Jamaica (UWI, 2001).

**Table 2.8 Pesticide imports to St Lucia, 1998-1999**

Category	Brand Name	AI chemical	Unit	1998	1999	Total
Fungicide	Cuprosan 311 SD	copper oxychloride	Kg	1.5	0.7	2.2
		Maneb	Kg	0.5	0.2	0.7
		Zineb	Kg	0.5	0.6	1.1
	Fungafloor 75 SP	Imazalil	Kg	1620.0	11932.0	13552.0
	Mancozeb 80% WP	Mancozeb	kg		87.5	87.5
	Phyton 27	ammonium formate	litres	0.1	9.0	9.1
		copper sulphate pentahydrate	litres	0.2	13.7	13.9
		sodium sulphate alquiletoxi	litres	0.1	3.2	3.3
	Ridomil MZ 72 WP	Mancozeb	kg	1600.0		1600.0
		Metalaxyl	kg	200.0		200.0
	Tilt 250 EC	Propiconazole	litres		682.5	682.5
	Trimiltox-Forte	copper calcium sulphate	kg	1.5		1.5
		copper carbonate	kg	0.8		0.8
		copper oxychloride	kg	2.3		2.3
		Mancozeb	kg	2.0		2.0
Vectra	Bromaconazole	litres		1.4	1.4	
Herbicide	2-4 D Amine	dichlorophenoxyacetic acid	litres	56.9		56.9
	Fusilade	fluazifop-p-butyl	litres	12.8	3.0	15.8
	Gramocil	Diuron	litres	1477.6	4666.8	6144.4
		Paraquat	litres	2955.2	9333.6	12288.8
	Gramoxone	Paraquat	litres	5820.0	13158.0	18978.0
	Reglone	Diquat	litres	12.0	1216.8	1228.8
	Talent	Asulam	litres		1291.1	1291.1
		Paraquat	litres		64.6	64.6
Touchdown	glyphosate-trimesium	litres	3913.0	14517.1	18430.1	
Insecticide	Actellic	pirimiphos-methyl	litres	28.0		28.0
	Actellic 50 EC	pirimiphos-methyl	litres		42.0	42.0
	Admire 2 Flowable	imidacloprid	litres	1.3		1.3
	Basudin	diazinon	litres	1.2	54.0	55.2
	Diazinon	diazinon	litres	86.6		86.6
	Diazinon 14G	diazinon	kg		1.7	1.7
	Diazinon 48 EC	diazinon	litres		49.5	49.5
	Dursban	chlorpyrifos	litres		33.6	33.6
	Dursban PT 270	chlorpyrifos	litres	0.3	0.9	1.2
	Karate	lambdacyhalothrin	litres	10.9		10.9
	Karate 2.5 EC	lambdacyhalothrin	litres		6.8	6.8
	Malathion	diazinon	litres		76.9	76.9
		malathion	litres	90.5		90.5
	Malathion ULV 91	diazinon	litres		17.2	17.2
	Sevin 5%	Carbaryl	kg	27.0		27.0
	Sevin 5% WP	Carbaryl	kg		24.3	24.3
	Sevin 80 Dust	Carbaryl	kg		90.4	90.4
	Sevin 85 S	Carbaryl	litres		18.5	18.5
	Sevin 85 WP	Carbaryl	kg	235.5	6.4	241.9
		cypermethrin	litres	80.5	16.4	96.9
Tambo 440 EC	profenofos	litres	805.2	163.8	969.0	
	endosulfan	kg		4.5	4.5	
Thiodan 50 WP	endosulfan	kg		4.5	4.5	
Trigard	cyromazine	kg	3.8	11.3	15.0	
Nematicide	Furadan 10G	carbofuran	kg	9000.0	9280.3	18280.3
	Miral 10G	isazofos	kg	7330.0	2220.0	9550.0
	Mocap 10G	ethoprophos	kg	6480.0	102085.2	108565.2
	Rugby	cadusafos	kg		1080.0	1080.0
	Vydate L	oxamyl	litres	2744.4	1865.0	4609.4

The list of imported pesticides (Table 2.8) has been used to determine pesticides for analysis (as detailed in Table 2.9). It was not possible to analyse all priority pesticides due to budgetary and laboratory constraints. The majority of pesticides will be analysed by both CEHI and the UK laboratory (Central Science Laboratory,

CSL), however minor variation occurs due to differing equipment availability. Table 2.9 also indicates nutrients that will be analysed to estimate fate of fertilisers in the environment (nitrate, nitrite, potassium, phosphorous). Fertiliser constituents have been ascertained with information collated from the Extension Services of MAFF during a project workshop held at the Still Plantation in Soufriere on 26<sup>th</sup> June 2001 (Kenward *et al.*, 2001).

**Table 2.9 List of agro-chemicals for analysis**

Agro-chemical	Group	Priority	Lab tests	Sampling regime
<b>Nutrients</b>				
Nitrate	Nutrients	H	CEHI only	Water, sediment, tissue
Nitrite	Nutrients	H	CEHI only	Water, sediment, tissue
Potassium	Nutrients	H	CEHI only	Water, sediment, tissue
Phosphorous	Nutrients	H	CEHI only	Water, sediment, tissue
<b>Group 1: organo-chlorine pesticides</b>				
Endosulfan	Organo-chlorine	H	CEHI+CSL	Water, sediment, tissue
Imazail	Organo-chlorine	L/M	CEHI+CSL	Water, sediment, tissue
Chlorpyrifos	Organo-chlorine	M	CEHI+CSL	Water, sediment, tissue
<b>Group 2: carbamate pesticides</b>				
Oxamyl	Carbamate	H	CEHI+CSL	Water, sediment, tissue
Carbaryl	Carbamate	L	CEHI+CSL	Water, sediment, tissue
Carbofuran	Carbamate	L	CEHI+CSL	Water, sediment, tissue
<b>Group 3: organo-phosphate pesticides</b>				
Ethoprophos	Organo-phosphate	H	CEHI+CSL	Water, sediment, tissue
Diazinon	Organo-phosphate	L	CEHI+CSL	Water, sediment, tissue
Malathion	Organo-phosphate	L	CEHI+CSL	Water, sediment, tissue
Pirimiphos-methyl	Organo-phosphate	L	CEHI+CSL	Water, sediment, tissue
Cadusafos	Organo-phosphate	L/M	CEHI+CSL	Water, sediment, tissue
Isazofos	Organo-phosphate	M	CEHI+CSL	Water, sediment, tissue
Profenofos	Organo-phosphate	M	CEHI+CSL	Water, sediment, tissue
<b>Group 4: bipyridinium compounds</b>				
Paraquat	Bipyridinium	H	CEHI+CSL	Water only (CEHI), Water, tissue (CSL)
Diquat	Bipyridinium	M	CEHI+CSL	Water only*
<b>Other groups of pesticides</b>				
Metalaxyl	Acylalanine	L	CEHI+CSL	Water, sediment, tissue
Cypermethrin	Pyrethroid	L/M	CEHI+CSL	Water, sediment, tissue
Lambdacyhalothrin	Pyrethroid	L	CEHI+CSL	Water, sediment, tissue
Cyromazine	Triazine	L	CEHI+CSL	Water, sediment, tissue
Propiconazole	Triazole	M/H	CEHI+CSL	Water, sediment, tissue
Diuron	Urea	L	CEHI+CSL	Water, sediment, tissue

### 2.3.2 Selection of watersheds

The selection of watersheds was discussed at a number of meetings held with various institutions and governmental bodies during November 2000 and June 2001 (Kenward and Mees, 2000; Kenward and Mees, 2001). Most people agreed that

banana production had the highest impact on watersheds in terms of agro-chemicals and land-use. Three watersheds have been chosen with a variety of agricultural uses and pressures, as described below:

*Watershed 1: Soufriere (17.2 km<sup>2</sup>)*

This is a low impact watershed situated on the windward side of the island with high levels of precipitation. There is limited commercial farming and low banana production (MB); the main agricultural crops are root vegetables (dasheen, yams) which use a high amount of fertilisers (NPK). This watershed is critical due to the fringing reef along this coastline. This is the sedimentation research site of York University and thus important to include in the agro-chemical component of the project.

*Watershed 2: Roseau (49.1 km<sup>2</sup>)*

This river basin is located in the banana belt of St Lucia and is well known to be heavily impacted by agriculture, principally by banana production. The construction of a high dam has considerably reduced water flow in the river. Banana cultivation is year-round using aerial- and ground spraying. The Forestry Department has produced a report detailing a significant decrease in birds (St Lucia aerial hedgefeeder) due to aerial spraying.

*Watershed 3: Praslin/Mamiku (16 km<sup>2</sup>)*

This site has been selected to contrast with the other study locations; it has different coastal and climatic characteristics from Watersheds 2 and 3 as it is on the Atlantic side of the island with much lower levels of rainfall. Two watersheds drain into Praslin Bay, which has no coral reef, however there is a mangrove stand along the lower river and coastline with offshore sea moss cultivation. There is a virtual absence of banana cultivation (except at Mamiku Estate) and the presence of diverse fruit, vegetable and flower cultivation. It is believed that the impacts of these crops are an important area of study since banana production is on the decline in St Lucia and they represent expected future trends in agriculture. Sampling of this watershed will include seamoss which is farmed in Praslin Bay.

**2.3.3 Locations of sampling sites in Roseau, Soufriere and Mamiku watersheds**

One of the objectives of the project workshop held with extension officers from MAFF Department of Agriculture (Kenward *et al.*, 2001) was to collate information about farming practices (crop type, soil conservation, irrigation, etc) and general location in the three study watersheds. Subsequent to the project workshop, surveys were made of the watersheds to select appropriate monitoring stations. Table 2.10 summarises information collected about the watersheds and describes selected monitoring stations.

**Table 2.10 Study watersheds: monitoring station locations and description**

<b>Mamiku</b>	<i>Watershed area: 16.0km<sup>2</sup> Boundaries: forested ridges either side of Mamiku valley. Main towns/villages are Mamiku, Mon Repos, Patience and La Pointe.</i>
<u>Station 1</u> (upper valley)	N 13°52.408' W 60°55.766' The river is fast flowing with some deep, still ponds. Water is sampled from centre of the river at the surface. Bottom sediment is sand. Crops on surrounding steep banks are coconut (immediately adjacent), banana, mango, tertiary forest, wild ferns and vines. Further away are cultivated dasheen and yams.
<u>Station 2</u> (mid valley)	N 13°51.912' W 60°54.520' The river becomes a series of mini waterfalls with some deeper, stagnant pools with sandy bottoms. There is a private water intake point near the sampling point and the pool here is turbid. The sampling point for water is mid stream, surface and for sediment is at the bottom of the stagnant pool near the intake point. The area is surrounded by uncultivated/minor cultivation slopes and is perhaps an abandoned plantation. There are cows and an empty pigsty. No crops adjacent to the river but coconut, mango, bananas, guavas and secondary bush further away on the slopes.
<u>Station 3</u> (lower valley)	N 13°52.199' W 60°53.849' Banana plantations continue almost to the shoreline and along the river until it becomes <i>Rhizophora</i> mangrove forest. The river has a very slow flow and is very turbid with muddy river banks. The sampling point is mid stream on the surface of the water.
<u>Station 4 (shore)</u>	N 13°52.616' W 60°53.443' Sampling was conducted close to the site of sea moss culture around the island in the middle of Praslin Bay. Bottom sediment in the bay is fine sand with some seagrass. Station 3 tissues were 9 crabs caught in traps in the river. Station 4 tissues were cultured species (sea moss) and wild molluscs (11 red topshells, 9 chiton, 3 nudibranchs, 55 whelks) which were collected from western (closest to river) side of the island (0-4m depth).
<b>Roseau</b>	<i>Watershed area: 49.1km<sup>2</sup> Boundaries (main towns/villages are Millet, Dame de Traversay, Durandean, Sarot, La Treille, Vanard, Jacmel, Jean Baptiste, Morne d'Or, Belair, Perou, Fond Manger, Collietown, Massacre, Roseau Distillery, Derriere Lagoon, Bois d'Inde, La Croix Maingot):</i> <ul style="list-style-type: none"> <li>• Upper watershed - from the forest reserve to Mont Gimie</li> <li>• Southern boundary - down the Venus/Anse La Raye ridge to Roseau</li> <li>• Northern boundary – down the Ladelac Sarrot ridge to Marigot</li> </ul>
<u>Station 1</u> (upper valley)	N 13°54.686' W 60°59.835' One of the main tributaries of the Roseau river passes through the Park Estate and this station is just below the Estate. The river is shallow and mainly bedrock and pebbles either side. There are spates of rapids then slower sections with pebbles and sand at bottom. Cultivation: dasheen, breadfruit, bananas, cocoa, coconut, tertiary forest and tree crops.

<u>Station 2</u> <u>(mid valley)</u>	N 13°55.721' W 60°59.485' This location is just below the confluence of tributaries to the main river below the village of Durandeu. The river is slow flowing with average 0.25m depth and deep silty pools. The LHS bank is a wide, low embankment with reeds whereas RHS is steep with banana and vines. Further from river, this is an area of cultivation of bananas, coconut palms, mango trees, pineapple, mixed vegetables (chilli peppers, tomatoes).
<u>Station 3</u> (lower valley)	N 13°57.353' W 61°01.237' The lower valley is intensively farmed with large banana plantations along both banks of the river. Sampling site is by the main coastal road bridge next to the school. The banks have a gentle gradient.
<u>Station 4</u> (shore)	N 13°57.776' W 61°01.950' At the outlet of Roseau River there is a narrow beach (with fishing boats) and no visible reef. The sampling point was adjacent to the sedimentation trap north of the river (direction of current) along the coastline which is rocky, descending steeply to 4.0m. Station 3 tissues were aquatic green macrophytes/algae (similar to <i>Ulva lactuca</i> ) (1 sample) and fish (juvenile <i>Tilapia</i> ) and crustacean (cray fish) (1 sample). Station 4 tissues were molluscs (5 whelks, 3 rough tops, 10 small conch), crustacea (1 hermit crab) and fish (3 goatfish, 1 parrotfish).
<b>Soufriere</b>	<i>Watershed area: 17.2km<sup>2</sup></i> <i>Boundaries:</i> <i>Forested ridges either side of Soufriere valley. Main towns/villages are Soufriere, Ruby, La Perle, Zenon, Cressland, Diamond, Esperance, Fond St Jacques, Toraille, Belvedere, Migny, St Phillip.</i>
<u>Station 1</u> <u>(upper valley)</u>	N 13°50.362' W 61°00.929' Sampling site on Jeremy/James River (main tributary of Soufriere River) just above Migny village. The river flow is rapid and there is sediment accumulation on both river banks (silt, sand). The river bottom is mostly composed of boulders. Around the river is an area of cultivation of mixed vegetables (dasheen, celery, parsley, cucumber, tomato, cabbage). We spoke to a farmer who uses Gramoxone after clearing field and before planting crop.
<u>Station 2</u> <u>(mid valley)</u>	N 13°50.258' W 61°01.678' Site below confluence of main tributaries to Soufriere river. The river flow is rapid with large boulders and silt/sand accumulated along the banks. Very steep banks adjacent to river with farming of breadfruit, citrus, pawpaw, coconut, pumpkin, banana, root crops and secondary forest (bush, vines, ferns). Lots of pools with sediment in the river. Access to river just below main road junction.
<u>Station 3</u> <u>(lower valley)</u>	N 13°51.405' W 61°03.367' Sampling station along the straightened section of the river through Soufriere town adjacent to constructed channel/dam with rip rap on one side (playing fields) and vegetated slope on the other. Lots of <i>Tilapia</i> fish in the dammed section of the river (sampled for Station 3 tissues).

<u>Station 4 (shore)</u>	N 13°51.485' W 61°03.815' Much of Soufriere Bay is protected by fringing reef with sediment below the reef crest. Sampling was conducted adjacent to sediment traps monitored by York to the north side of the main bay (direction of longshore current flow). Station 4 tissues are molluscs (9 slugs, 3 cowries, 68 rough tops).
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**Table 2.11 Characteristics of water sampling stations**

Date	Watershed	Station	Width (Metres)	Depth (Metres)	pH	Temperature (°C)	Salinity (ppt)
26/11/01	Mamiku	1	5.0	0.15	6.73	25.1	0.00
26/11/01	Mamiku	2	9.1	2.1	7.66	25.5	0.00
26/11/01	Mamiku	3	6.0	2.3	7.15	26.2	0.70-4.00
28/11/01	Mamiku	4	Na	4.0 sand 0.0-4.0 tissue	8.13	28.8	35.30
27/11/01	Roseau	1	4.9	0.3	7.98	25.8	0.00
27/11/01	Roseau	2	7.7	0.25	7.95	28.6	0.00
27/11/01	Roseau	3	14.4	0.8	7.25	27.6	0.10
29/11/01	Roseau	4	Na	4.0 sand 0.0-4.0 tissue	8.25	28.9	35.60
27/11/01	Soufriere	1	1.5	0.4	7.25	23.2	0.00
27/11/01	Soufriere	2	1.4	0.8	7.49	24.3	0.00
27/11/01	Soufriere	3	5.1	1.4	7.21	27.1	0.10
29/11/01	Soufriere	4	Na	4.0 sand 0.0-4.0 tissue	8.29	28.7	35.80

### 2.3.4 Sampling procedures

CEHI is the regional institution with pesticide analytical capabilities and was responsible for conducting sampling and the majority of analyses. Collaboration has been organised so that all samples are collected by the project research assistant (Nicole Esteban) and CEHI. As detailed above (see Table 2.9), CEHI will analyse two of the replicate samples. A third replicate will be sent to a UK certified laboratory (Central Science Laboratory, DEFRA) for analysis. This verification will aid CEHI in their quality control.

### 2.3.5 Sampling design

As detailed in Table 2.10, sampling at all three watersheds took place in four locations: the upper catchment, mid catchment, estuarine outlet and coastal reef/lagoon. At each monitoring station, 2 matrices were sampled: water and sediment. Additionally, tissue (fish/invertebrate/algae) was sampled in the estuarine outlet and coastal reef/lagoon. The possibility of contaminated drinking water was also highlighted by several institutions (Water Resources Management Unit, WASCO) and it was therefore decided to include a drinking water extraction point. Sampling of drinking water extraction points was conducted in collaboration with WASCO (Mr Raphael Eudovique). Sampling of species farmed by aquaculture (Praslin/Mamiku: seamoss in Praslin Bay) has also been included in the survey. The sampling design matrix is shown in Table 2.12. Wherever possible, all matrices will be analysed for individual chemicals, however it is not possible to analyse for certain groups of chemicals in sediment (e.g., Diquat and paraquat).

**Table 2.12 Sampling design for three watersheds in St Lucia (Mamiku, Soufriere, Roseau)**

Stations	Matrices			
	Water	Sediment	Fish/invert	Algae
Farm	3	3	0	0
Mid course	3	3	0	0
Estuary	3	3	3	1 (Roseau)
Reef	3	3	3	0
Drinking water abstraction point	1	0	0	0
Aquaculture	0	0	0	1
CSL (1 replicate/station)	13	12	6	2
CEHI (2 replicates/station) <sup>1</sup>	26	24	12	4
Total	<b>39</b>	<b>36</b>	<b>18</b>	<b>6</b>

### 2.3.6 Sampling methodology

All sampling took place during a period of six days (between 26 November and 1 December 2001). Sampling was carried out by the project researcher, Nicole Esteban in association with CEHI and WASCO (drinking water abstraction point only). Samples were then transported to the CEHI laboratory, prepared and placed in solvent (tissues) Dichloromethane (Mallinckrodt Nanograde). One-third of samples were then prepared for onward transportation to CSL laboratory in the UK. Samples were hand delivered to CSL by Nicole Esteban in order to ensure that samples are kept chilled (water samples in glass bottles) or frozen (all other samples). Sampling methodology for the different matrices varies and is described in the next section.

### 2.3.7 Water

The vertical profile of sampling is important, as some pesticides are non-soluble in water and so form a film on the surface. Water was thus sampled from the surface of the water column. A total of 3 litres (2 litres for CEHI and 1 litre for CSL) was collected at each monitoring station. 1.5 litres was collected into glass bottles (some pesticides diffuse into plastic, e.g., cypermethrin) and 1.5 litres was collected into plastic bottles (other pesticides plate out or adsorb onto glass, e.g., paraquat). Stations 1-2 were freshwater, station 3 was freshwater/brackish and station 4 was seawater. Solvent was added into glass bottles to prevent water insoluble compounds from plating onto glass (e.g. cypermethrin).

### 2.3.8 Sediment

It is preferable to sample sediment with small grain sizes (e.g., organic-rich mud, clay) as pesticides diffuse to the organic portion of sediments. Approximately 300 grams of sediment (200 grams for CEHI and 100 grams for CSL) was sampled from the surface at the side of the rivers. Sediment was collected from station 4 (reef) by

<sup>1</sup> The exception is paraquat, which will be analysed by CEHI (2 replicates of water only) and UK lab (1 replicate of water, 3 replicates of tissues)

snorkel. In the case of Soufriere and Roseau, sediment was collected from a location close to sediment traps laid by the University of York.

### **2.3.9 Tissues**

Sessile invertebrates (e.g., mussels, clams) were collected in preference to fish as they can be taken from a fixed location. Invertebrates also have higher fat content and fat-soluble pesticides are therefore more easily detectable in their tissues. Where it was not possible to find invertebrates, it was necessary to collect fish. In this case, reef-resident species (surgeonfish) were purchased from local fishermen. Approximately 300 grams of tissues are required for analytical purposes (200 grams for CEHI and 100 grams for CSL).

### **2.4 Critical control points for dissemination of research outputs**

A flow chart to indicate critical control points for dissemination of project outputs had been prepared with information collected during the last project trip. Critical control points and target institutions were discussed during meetings and the flow chart will be updated with information included in this report. This flow chart has not yet been finalised and readers of this document are kindly requested to send any information/feedback to the author.

<b>Critical control points for agro-chemical management</b>			
	<b>Critical control point?</b>	<b>Management options</b>	<b>Target audience &amp; implementer</b>
<b>Import</b>	Port Authority	Import/monitoring procedures Legislation System to deal with illegal imports System for banned substances	
	Customs & Excise	Import/monitoring procedures Legislation Feedback mechanisms System for banned substances	
	Pesticide Control Board	Legislation Import/monitoring procedures Feedback mechanisms System for banned substances Inspections	
	Import agent	Legislation Import/monitoring procedures Inspections	
<b>Manufacture</b>	Manufacturer/Chemical Company	Recommendations/guidelines Appropriate Packaging Appropriate Labelling	
	Pesticide Control Board	Legislation Inspections	
<b>Purchase &amp; Distribution</b>	Agricultural Boards & Associations	Legislation Inspections Recommendations/guidelines Appropriate Packaging Appropriate Labelling	Pesticide Control Board
	Farm shops		
	Chemical company depots		
	Agricultural Extension Services		
<b>Application</b>	Plantation - pesticide operator	Legislation Inspections & licensing Recommendations/guidelines Appropriate Packaging Appropriate Labelling Appropriate Disposal Secure Storage Avoid contamination Soil management (fertility, conservation)	Agricultural Extension Services
	Small/medium farm - farmer		Waste Management Unit
			Department of Health
			Pesticide Control Board

**Figure 2.1 Draft framework detailing critical control points**

### 3 REFERENCES

Dasgupta (2001) Draft toxicity review. Prepared for the DFID NRSP LWI project R7668. Jamaica: Mona Campus, Department of Chemistry.

Kenward and Mees (2000) Project inception report. December 2000. Prepared for the DFID NRSP LWI project R7668. Available on [www.mragltd.com](http://www.mragltd.com).

Kenward and Mees (2001) Project trip report. June 2001. Prepared for the DFID NRSP LWI project R7668. Available on [www.mragltd.com](http://www.mragltd.com).

Kenward, Mees, Eudovique and Simpson (2001) Proceedings of project workshop. 26 June 2001, Still Plantation, St Lucia.

## 4 ANNEXE 1: ITINERARY

Itinerary  
Nicole Esteban

R7668 (trip #3)  
20 Nov – 2 Dec 2001

Tuesday 20	<i>Travel (BA4521 LGW 1030hrs – Kingston 1530hrs) Hotel: Four Seasons (tel: 876 926 8805, fax: 876 929 5964)</i>
Wednesday 21	Review and confirm meetings Visit STATIN, Kingston
Thursday 22	0830: UWI-CMS (George Warner) 1000: Round-table (UWI, DoC, CMS, DoLS, CARDI, C-CAM) 1500: WRA (Basil Fernandez) 1600: SRC (Library)
Friday 23	0900: PCA (Hyacinth Chin Sue) 1030: UNEP (Alessandra Khoury) 1300: RADA (Thomas Burton) 1430: DoC (Tara Dasgupta, Melvin Spencer, Dale Webber) 1630: RADA (Phillip Chung)
Saturday 24	<i>Travel (JM67 Kingston 1110hrs – Mo'Bay 1150hrs, JM91 Mo'Bay 1250hrs – StL 1625hrs) Hotel: Still Plantation, Soufriere</i>
Sunday 25	1400: Anse Chastanet Dive Centre
Monday 26	0900: CEHI Field sampling – Praslin (stations 1-3)
Tuesday 27	0830: Still Plantation, Soufriere Field sampling – Soufriere (station 1-3) and Roseau (station 1-3)
Wednesday 28	0830: CEHI Boat sampling – Praslin (station 4)
Thursday 29	0830: Anse Chastanet Boat sampling – Soufriere (station 4) and Roseau (station 4)
Friday 30	0830: CEHI (laboratory preparation – dissection of samples) 1100: Everton Ambrose (Project Mid Term Review) 1500: Marigot Bay (field sampling Roseau station 4)
Saturday 1 Dec	0900: Sampling at Station 3 Roseau for tissues 1200: Laboratory preparation (CEHI)
Sunday 2	<i>Travel (BA 1955hrs – LGW 1110 on 3/12)</i>

## 5 ANNEXE 2 – CONTACT DETAILS

(NB. List of contacts are sorted by country and last name)

First Name	Last Name	Company/Institution	Job Title	Country	Business Fax	Business Tel	Email Address
Florita	Kentish	Pesticide Control Board - Antigua	Chairperson	Antigua		268 4624962	diragr@candw.ag
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