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Appendix I

Workshop Agenda

Monday, 11 September

Participants arrive in Zanzibar.

Tuesday, 12 September

- 0900 Welcome and announcements – Dr Amani Ngusaru, Institute of Marine Science, Zanzibar
- Introduction of participants
- 0930 Introduction to LOICZ and IGBP – Chris Crossland
- 1000 Introduction to LOICZ budgeting approach and project overview – Stephen Smith
- 1030 Biogeochemical budgets calculation and web information – Vilma Dupra
- 1100 Coffee break
- 1115 Typology and scaling in LOICZ – Dennis Swaney
- 1145 Outline of the LOICZ biogeochemical budgets web site – Dennis Swaney
- Discussion
- 1230 Lunch
- 1330 Tools: Presentation of CABARET budgeting software – Laura David
- 1400 Tools: Calculation of river discharge values – Laura David
- 1415 Tools: Calculation of waste loads – Laura David
- 1430 Participant presentation of sites and preliminary budgets
- 1800 Session close

Wednesday, 13 September

- 0900 Plenary discussion of continuing work plan and resource person collaborations
- 0930 Breakout groups working on site budget preparation
- 1230 Lunch
- 1330 Plenary discussion of status of work and problems
- 1345 Break out groups resume work on budget derivation.
- 1745 Plenary review of status of work for evening continuation

Thursday, 14 September

- 0900 Breakout groups continue
- 1115 Budgets presentations by participants
- 1230 Lunch
- 1330 Budget presentations continue
- Identification of additional sites for budget estimates
- 1630 Synthesis and wrap-up session, and discussion of future activities of the group
- 1730 Workshop close

Friday, 15 September

Participants depart Zanzibar

Welcome

Participants (see Appendix III) were welcomed to Zanzibar and the venue at the Fisherman's Resort by Dr Amani Ngusaru, on behalf of the Zanzibar Institute of Marine Sciences, University of Dar es Salaam, and meeting support arrangements were reviewed. The workshop agenda (Appendix I) was introduced, and working documents, electronic information and tutorial materials were distributed.

Introduction and Background

LOICZ goals and approaches were presented by Dr Chris Crossland and a context for the workshop activities and outcomes was provided against the wider questions of the LOICZ core project and the UNEP project. Emphasis was given to the central questions of evaluating material fluxes, the influence of human dimensions on global changes in processes within the coastal zone, and the use of a typology approach to develop a global picture of systems responses and changes. A round-table introduction of participants was made. The purpose of the workshop was outlined by Prof. Stephen Smith within an overview presentation of the LOICZ budgeting and modeling approach for nutrient flux and net ecosystem metabolism of estuarine and coastal sea systems.

In an introductory tutorial, Vilma Dupra provided participants with a description of the development and calculation of nutrient budgets models, including single box, stratified and multi-compartment assessments. A tutorial handbook (LOICZ Biogeochemical Budgeting Procedure: A Tutorial Pamphlet, prepared for the UNEP GEF project by the Marine Science Institute, University of the Philippines) was provided to all participants and supported the tutorial presentation.

The typology approach being developed by LOICZ for up-scaling local and regional material flux assessments to global scale was outlined by Dennis Swaney. The LOICZView tool and the extensive database for half-degree description of the global coastal zone were discussed and the planned integration of regional data through thematic workshops in 2001, as part of the project, was highlighted.

Various tools developed by LOICZ to assist in estimating water and biogeochemical material inputs to systems were reviewed by Dr Laura David. Calculation parameters, location and access to the tools were identified and examples proved as case evaluations. Electronic versions of the biogeochemical budget calculation software (CABARET), waste load estimations, and river discharge evaluation were provided to participants.

Presentation of Biogeochemical Budgets

The contributing budgets brought by the participants were briefly considered, including an overview of the system settings, data availability and quality, approaches being taken to build budgets, and the status and problems in making the model assessments. System sites included:

Tanzania

Chwaka Bay, Zanzibar

Kenya

Malindi Bay (Sakaki River system)

Cameroon

Bouche du Cameroon mangrove systems including:

Cameroon estuary

Lobe estuary

Guinea

Korikaufe estuary

South Africa

Knysna estuary

Swartkops estuary

Kromme estuary

Gamtoos estuary

Sundays River estuary
Thukela estuary
Mhlathuze estuary
Nhlabane estuary

Budgets Development

Break-out groups worked interactively on the development of these site budgets, supplemented with methodological and site/issue-based tutorials and discussions. Estimates for sites, and budgets refinement emerged from resolution of techniques, application of derivative data and assessment of watershed information.

Plenary and discussion sessions were held throughout the workshop. These enabled review of the status of budgets development and discussion of key issues raised by participants, as well as allied topics, such as: C:N:P ratio and stoichiometry, limits and “reasonable” values in budget assessments, scaling variables and typology.

Outcomes and Wrap-up

Budgets for all systems were developed to a final or interim draft stage of completion during the workshop; additions to text descriptions and a check on data sources were required by most budgets before final contribution. A schedule for contribution and publication of the printed and CD-ROM report, and posting to the LOICZ website, was agreed:

20 October	revised final budgets to Prof. Smith and Vilma Dupra
30 November	final budgets to IPO for LOICZ R&S preparation
15 January	draft R&S report to UNEP for comment
29 January	R&S to printer

A number of additional sites was identified for which data is available and which may yield budgets. Participants committed to making other site budgets, subject to data availability, and to encourage others to make further site assessments. Prof. Howard Waldron, University of Cape Town, accepted the role of Regional Mentor – Africa for the project, with support from Prof. Baird, and participants discussed possibilities to expand the network of researchers and site budget potential for the region.

The participants joined with LOICZ in expressing thanks to Dr Amani Ngusaru and Edna Nyika from the Zanzibar Institute of Marine Sciences for support and hosting of a very fruitful training and information workshop. The financial support of the Global Environment Facility was gratefully acknowledged.

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**LOICZ/UNEP WORKSHOP ON ESTUARINE SYSTEMS
OF THE SUB-SAHARAN AFRICA & WESTERN INDIAN OCEAN REGION**

**Institute of Marine Science,
University of Dar es Salaam
ZANZIBAR, TANZANIA
12-14 September 2000**

Primary Goals:

To work with researchers dealing with estuarine systems of the Sub-Saharan Africa and western Indian Ocean region, in order to extract C,N,P budgetary information from as many systems as feasible using existing data. The Sub-Saharan Africa and western Indian Ocean systems include one of the major coastal regions of the world oceans and are heavily influenced by anthropogenic activity. The workshop provides the opportunity to characterize terrigenous inputs to the estuaries of the region, and outputs from the estuaries – hence, the net role of the estuarine zone of this region as a source or sink for carbon, nitrogen, and phosphorus.

This workshop will complement earlier, successful workshops in Ensenada, Mexico, in June 1997, a second Mexico workshop in January 1999 (Merida, Mexico), an Australasia workshop (Canberra, Australia) in October 1998, a South China Sea workshop (Manila, Philippines) in July 1999, a South America workshop in November 1999 (Bahia Blanca, Argentina), a South Asia workshop in February 2000 (Goa, India) and an East Asia workshop in Hong Kong in June 2000, by the analysis of data from another important coastal region.

It is hoped that each workshop participant will be able to bring the available data for at least two budgets: one from one of the "pollution hot spot" regions within their country, and one for a physiographically fairly similar region which is apparently subjected to less pollution. By this strategy, we hope to compile a set of sites that will represent a relatively wide range of human pressures in the Sub-Saharan Africa and western Indian Ocean region.

Anticipated Products:

1. Develop budgets for as many systems as feasible during the workshop.
2. Examine other additional data, brought by the researchers, or provided in advance, to scope out how many additional systems can be budgeted over an additional 2 months.
3. Prepare a LOICZ technical report and a CD-ROM summarizing this information.
4. Contribution of these sites to 1-2 papers to be published in the refereed scientific literature.
5. It is anticipated that one participant from the workshop will be offered the opportunity to spend up to two months in Hawaii and/or Manila, getting further experience and developing additional budgets for the region.

Participation:

The number of participants will be limited to fewer than 18 persons, to allow the active involvement of all participants. Nominees include:

- Resource persons (possible participants are Stephen Smith, Vilma Dupra, Laura David, Chris Crossland, Dennis Swaney);
- Up to 13 researchers from the region.

Workplan:

Participants will be expected to come prepared to participate in discussions on coastal budgets. Preparation should include reading the LOICZ Biogeochemical Modelling Guidelines (Gordon *et al.* 1996), the Mexican Lagoons Workshop Report (Smith *et al.* 1997), examination of the budgets and

tutorials presented on the LOICZ Modelling web page (<http://data.ecology.su.se/MNODE/>), and arriving with preliminary budgets, electronic maps, and 1-3 page writeups from “their sites.” In order to be included in the workshop report, the budgets should conform as best possible to the budgeting protocol laid out in the above documentation. Guidelines for budget preparation and writeups and a tutorial package entitled CABARET can (and should) be downloaded from the LOICZ Modelling web site.

NOTE: Please try to conform to materials on that web site as closely as possible, because this will greatly aid in report preparation. We anticipate structuring the workshop very strongly towards instruction and then working with individuals to complete budgets during the workshop.

Further Details:

At an absolute minimum, each participant is expected to arrive at the workshop (or send in advance) the following materials:

1. A 1-3 page description of the area (see materials posted on the Web and in the various workshop reports) and a map of the site. These should be in electronic format.
2. Within the context of needs for the overall LOICZ project, some estimate of water exchange (most commonly via water and salt budgets) and budgets for the dissolved inorganic nutrients, nitrogen and phosphorus, constitute the minimum useful derivations from the biogeochemical budgeting. Budgets of other materials, while potentially interesting for other purposes do not satisfy this minimum requirement. The minimum data requirements are as follows:
 - a. The primary seasonal pattern of the region is at least one wet season and one dry season per annum. Ideally, a budget for each season would be developed. If a system is vertically stratified, then a 2-layer budget is preferred over a single-layer budget. If a system has a strong land-to-sea salinity gradient, then it is preferable to break the system along its length into several boxes.
 - b. Data requirements to construct a satisfactory water and salt budget include: salinity of the system and the immediately adjacent ocean, runoff, rainfall, evaporation, and (if likely to be important) inputs of other freshwater sources such as groundwater or sewage. Preferably, the salinity and freshwater inflow data are for the same time period (for example, freshwater inflow data for a month or so immediately prior to the period of salinity measurement). In the absence of direct runoff estimates for small catchments, estimations can be made from a knowledge of catchment area and monthly rainfall and air temperature for the catchment. See materials on the LOICZ biogeochemical modeling web site.
 - c. Data requirements for the nutrient budgets are: concentrations of dissolved nutrients (phosphate, nitrate, ammonium, and if available dissolved organic N and P) for the system and the adjacent ocean, concentrations of nutrients in inflowing river water (and if important, in groundwater), some estimate of nutrient (or at least BOD) loading from sewage or other waste discharges. If atmospheric deposition (particularly of N) is likely to be important, an estimate of this is also useful. If direct waste load measurements are not available, estimations can be made from a knowledge of the activities contributing to the waste loads and the magnitudes of those activities. See the materials on the web site.

Workshop Schedule

(All final participants are expected to stay for the entire workshop):

September 11: Arrival

September 12: General introduction to the budgeting procedure and related issues; presentation of preliminary budgets (no details, simply a quick summary to see who has what).

Breakout groups to revise, refine budgets. This will vary, as needed, from tutorial, through detailed help, to procedural discussions.

September 13: Continue breakouts; afternoon plenary to evaluate progress.

September 14: Breakouts/plenary as required to develop synthesis.

September 15: Departure.

Background Documents:

Gordon, D.C. Jr., Boudreau, P.R., Mann, K.H., Ong, J.-E., Silvert, W.L., Smith, S.V., Wattayakorn, G., Wulff, F. and Yanagi, T. 1996. LOICZ Biogeochemical Modelling Guidelines. *LOICZ Reports and Studies* **5**, LOICZ, Texel, The Netherlands, 96 pages.

Smith, S.V., Ibarra - Obando, S., Boudreau, P.R. and Camacho Ibar, V.F. 1997 Comparison of carbon, nitrogen and phosphorus fluxes in Mexican coastal lagoons. *LOICZ Reports and Studies* **10**, LOICZ, Texel, The Netherlands, 84 pages.

LOICZ Modelling web page, for everyone with www access:(<http://data.ecology.su.se/MNODE/>).

- The web pages, including the guidelines, are frequently updated. If you have not looked at them within the last two weeks, you should go through them again (For example, there are recent additions on estimation of runoff and estimation of waste loads).
- If you do not have access to the worldwide web but do have access to a computer with a CD-ROM, please let us know; we will send you a CD with the web page. Please do not request the CD at this time if you have access; you will be furnished one during the workshop.
- CABARET (Computer Assisted Budget Analysis, Research, Education, and Training). Note: a version of this software is available on the web-site.

Appendix V Glossary of Abbreviations

NH ₄	Ammonium
NO ₃	Nitrate
DIN	Dissolved inorganic nitrogen
DON	Dissolved organic nitrogen
DIP	Dissolved inorganic phosphorus
DOP	Dissolved organic phosphorus
PTN	Particulate total nitrogen
PTP	Particulate total phosphorus
POP	Particulate organic phosphorus
PON	Particulate organic nitrogen
ON	Organic nitrogen
OP	Organic phosphorus
TN	Total nitrogen
TP	Total phosphorus
DOC	Dissolved organic carbon
DIC	Dissolved inorganic carbon
POC	Particulate organic carbon
OC	Organic carbon
SiO ₄	Silicate
nfix	Nitrogen fixation
denit	Denitrification
p	Primary production
r	Respiration
TDN	Total dissolved nitrogen
TDP	Total dissolved phosphorus
CTD	Conductivity Temperature Depth